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ADVANCED METALLIC STRUCTURES: AIR SUPERIORITY FIGHTER WING DESIGN FOR IMPROVED COST, WEIGHT AND INTEGRITY

VOLUME II DESIGN DATA

D. F. Davis, et al.

GENERAL DYNAMICS
Convair Aerospace Division
Fort Worth Operation

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F O R E W O R D

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These studies were performed by the Structural Design Group, Convair Aerospace Division of General Dynamics, Fort Worth Operation with D. F. Davis as the Program Manager. Other principal participants in the program are as follows: R. W. McAnally, Structural Design; E. W. Gomez, Stress Analysis; J. W. Morrow, Fatigue and Fracture Analysis; J. M. Shults, Materials Engineering; T. E. Henderson, Mass Properties; J. D. Jackson, Value Engineering; J. L. McDaniel, Manufacturing Engineering; B. G. W. Yee, Nondestructive Inspection; D. Duncan, Quality Assurance; H. E. Bratton, Information Transfer; and R. L. Jones, Engineering Test Laboratory.

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This report has been reviewed and is approved.

John C Frishett

JOHN C. FRISHETT, Major, USAF
Program Manager, AMS Program Office
Structures Division
Air Force Flight Dynamics Laboratory

A B S T R A C T

This report describes the preliminary design and analysis for an Advanced Air Superiority Fighter Stores Loaded, Wet Wing Structure. The wing box of the F-111F airplane designed by the Convair Aerospace Division of General Dynamics was used as the baseline vehicle.

A unique design methodology was followed to arrive at three configurations which offer an optimum balance between structural efficiency and technological advancement. This methodology consists of compiling element concepts; integrating them into cross-section drawings; optimizing them in analytical assemblies; and finally preparing full wing box designs. Each step was followed with a detailed evaluation and ranking step which utilized a formal merit rating system. This system permitted the evaluation of numerous concepts and insured that each technical discipline participated in the design selection.

A subsequent program is proposed to evaluate the capability of the selected design to meet the overall program goals of advancing technology without significantly affecting costs. The subsequent program involves additional preliminary design, a development test program, detail design, manufacture, and tests; including static, fatigue, and damage tolerance testing. Information generated during this effort will be disseminated to the Air Force and industry in general through an intensive information transfer effort.

TABLE OF CONTENTS

TABLE OF CONTENTS (Continued)

LIST OF ILLUSTRATIONS

LIST OF TABLES

APPENDIX I

ELEMENT CONCEPT SKETCHES

I.1 SUMMARY

During the initial step of the Concept Formulation Phase, one-hundred nineteen (119) Element Concepts were documented. An additional twenty-seven (27) concepts were generated during the cross-section drawing phase of the program. Their weight saving potential was established as part of this effort.

Evaluation and utilization of these concepts were based on qualitative and quantitative data discussed in this report. Manufacturing and NDI evaluations were basically qualitative, generally relying on comparison to known industry standards. The wing skin panel concepts were analyzed using a computer program created especially for this effort. It is a screening procedure incorporating an iterative weight minimization scheme which utilizes Ramberg-Osgood simulations of material stress-strain curves. This program permitted a quantitative evaluation of the potential weight savings for over one-hundred (100) skin concepts.

I.2 CONCEPT EVALUATION AND UTILIZATION

An effort was made during the first few weeks of this program to collect previously used structural concepts, new and innovative structure concepts, and concepts from other Advanced Development Programs. As the collection grew, efforts to evaluate the concepts were initiated. During the latter portions of this phase, the most promising concepts were used in Cross-Section Drawings - the results of this activity are discussed below.

I.2.1 Concept Evaluation

Evaluation of concepts was based on their potential to save weight, their producibility, and their inspectability. Each of these is discussed below.

I.2.1.1 Identification of Weight Saving Potential

Well over 100 candidate surface panel concepts have been proposed for further development and evaluation as complete wing cross-sections and, subsequently, as analytical assemblies. Each concept has been assigned a number for identification and submitted as a preliminary drawing. Panel concept weights are affected by the following variables:

- Material properties

- Load level (high loads @ C.S.S. 140, low loads @ C.S.S. 340)

- Load type (upper surface panel weights reflect compression load requirements; lower surface panel weights reflect tension load requirements).

- Panel size (wide column lengths and plate widths).

- Panel cross-section (such as honeycomb sandwich, truss core of blade stiffened skin).

- Damage tolerance category (fail-safe, safe crack growth and holes vs. hole-free).

The calculated weight for the panel concepts are shown in Tables I through IV and are intended for use as screening aids to compare the weight saving potential of the competing concepts. It should be noted that some 610R-XXX drawings are listed. These are cross-section drawings which were analyzed using the computer program but which were not assigned an Element Concept Number (610-XXX). Copies of these drawings are included in Appendix II (Summary of Cross-Section Drawings).

The screening weights first-iteration sizings based on optimum panel cross-sections and, in most cases, do not include allowances for differences in the weights of fasteners, braze alloy and secondary support requirements. Thus, the indicated weights are considered as minimum weight potentials for the various panel concepts. Those concepts which are selected for further development as analytical assembly components will be sized and weighed in greater detail so as to reflect the many secondary considerations associated with realistic structural weights.

Definitions of terms used in the screening weight tables are as follows:

$W_{t_{TOT}}$ = Total weight of skin panel and spar cap load carrying material in lbs. per inch of span.

W_{STATIC} = Weight based on ultimate static load consideration on lower surface.

K = Allowable stress reduction factor imposed by fatigue and/or damage tolerance requirements.

FS: = Denotes fail-safe structure without holes

SCG: = Denotes slow crack growth (non-fail-safe) structure without holes

FSH: = Denotes fail-safe structure with holes

SCGH: = Denotes slow crack growth structure with holes

Definitions of terms used in the screening weight tables are as follows:

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SCG: = Denotes slow crack growth (non-fail-safe) structure without holes

FSH: = Denotes fail-safe structure with holes

SCGH: = Denotes slow crack growth structure with holes

Table I

WING SURFACE PANEL CONCEPT WEIGHT ESTIMATES
(WING CSS 140 - UPPER SURFACE)

Concept No.	Concept Description	Material	Wt TOT
610-012	Modified Triangular	AL 7050-T76	3.00
610-012	Modified Triangular Truss Core	Ti 6AL-4V (Ann.)	2.36
610-021	Multiple Rectangular Tubes	Ti 6AL-4V (Ann.)	2.35
610-021	Multiple Rectangular Tubes	Ti 8-8-2-3	2.28
610-021	Multiple Rectangular Tubes	Ti 6AL-4V STA	2.16
610-032	Y-Tee Stiffened Skin	Ti 8-8-2-3	2.04
610-034	Triangular Truss Core	AL 7050-T76	2.86
610-034	Triangular Truss Core	Ti 6AL-4V STA	1.93
610-034	Triangular Truss Core	Ti 8-8-2-3	2.08
610-034	Triangular Truss Core	Ti 6AL-4V (Ann.)	2.23
610-101	Integral Tee Stiffened	Ti 6AL-4V STA	2.02
610-101	Integral Tee Stiffened	Ti 8-8-2-3	2.10
610-101	Integral Tee Stiffened	Ti 6AL-4V (Ann.)	2.32
610-105	Integral Blade Stiffened	Ti 6AL-4V STA	2.18
610-105	Integral Blade Stiffened	Ti 8-8-2-3	2.25
610-105	Integral Blade Stiffened	Ti 6AL-4V (Ann.)	2.33
610-105	Integral Blade Stiffened	AL 7050-T7651	2.87
610-118	Integral Formed Bulb Tee	Ti 6AL-4V (Ann.)	2.30
610-118	Integral Formed Bulb Tee	AL 7050-T76	2.85
610-118	Integral Formed Bulb Tee	Ti 6AL-4V STA	2.02

Table I (Cont'd)

WING SURFACE PANEL CONCEPT WEIGHT ESTIMATES
(WING CSS 140 - UPPER SURFACE)
(Con't)

	Concept No.	Concept Description	Material	Wt TOT
	610-124	Hat Stiffened Skin	Ti 6AL-4V STA	2.02
	610-124	Hat Stiffened Skin	Ti 6AL-4V (Ann.)	2.30
	610-124	Hat Stiffened Skin	AL 7050-T76	2.91
	610-128	Honeycomb Sandwich Panels	AL 7050-T76	2.81
	610-128	Honeycomb Sandwich Panels	Ti 6AL-4V STA	2.03
	610-200	Laminated Plate (B = 9.5)	Ti 8-8-2-3	4.16
		Sculptured Plate Fixed Edge	AL 7050-T7651	3.06
*	610R-000	Baseline-Sculptured Plate	AL 2024-T851	3.25
*	610R-007	Full-Depth Core: Large Cell	Ti 8-8-2-3	2.38
*	610R-010	Honeycomb Panels	Ti 8-8-2-3	1.98
*	610R-011	Honeycomb Panels	Ti 6AL-4V STA	1.91
*	610R-013	Hat Stiffened Skin	AL 7050-T76	2.81
*	610R-014	Laminated Skin; Full Depth Core	Ti 6AL-4V STA	2.01
*	610R-014A	Space Truss-Welded Tube	Ti 6AL-4V STA	1.85
*	610R-028	Honeycomb Sandwich Panels	AL 7050-T76	2.81
*	610R-029	Sculptured Skin; Fixed Edges	AL 7050-T76	3.09

*Element concepts documented on Cross-Section Drawings only - Refer to Appendix II; Phase Report, Cross Section Drawings.

Table II

WING SURFACE PANEL CONCEPT WEIGHT ESTIMATES
(CSS 140 - LOWER SURFACE)

Concept No	Concept Description	Materials	Damage Mode	W Static	K_σ	Wt TOT
610-012	Modified Triangular Core	AL 7050-T76	FS	2.54	1.00	2.54
610-012	Modified Triangular Core	AL 7050-T76	SCG	2.54	1.24	3.15
610-021	Multiple Rectangular Tube	Ti 6AL-4V (Ann.)	FS	2.05	1.00	2.05
610-021	Multiple Rectangular Tube	Ti 6AL-4V (Ann.)	FSH	2.05	1.17	2.40
610-021	Multiple Rectangular Tube	Ti 6AL-4V (Ann.)	SCG	2.05	1.21	2.48
610-021	Multiple Rectangular Tube	Ti 6AL-4V (Ann.)	SCGH	2.05	1.21	2.48
610-021	Multiple Rectangular Tube	Ti 8-8-2-3	FS	1.73	1.00	1.73
610-021	Multiple Rectangular Tube	Ti 8-8-2-3	FSH	1.73	1.64	2.84
610-021	Multiple Rectangular Tube	Ti 8-8-2-3	FSG	1.73	1.64	2.84
610-021	Multiple Rectangular Tube	Ti 8-8-2-3	SCGH	1.73	1.72	2.97
610-032	Y-Tee Stiffened Skin	Ti 8-8-2-3	FS	1.73	1.00	1.73
610-032	Y-Tee Stiffened Skin	Ti 8-8-2-3	SCG	1.73	1.64	2.84
610-034	Triangular Truss Core	Ti 6AL-4V (Ann.)	FS	2.06	1.00	2.06
610-034	Triangular Truss Core	Ti 6AL-4V (Ann.)	SCG	2.06	1.26	2.60
610-034	Triangular Truss Core	Ti 8-8-2-3	FS	1.73	1.00	1.73
610-034	Triangular Truss Core	Ti 8-8-2-3	SCG	1.73	1.64	2.84
610-034	Triangular Truss Core	AL 7050-T76	FS	2.54	1.00	2.54
610-034	Triangular Truss Core	AL 7050-T76	SCG	2.54	1.24	3.15
610-101	Integral Tee Stiffened	Ti 6AL-4V (Ann.)	FS	2.05	1.00	2.05
610-101	Integral Tee Stiffened	Ti 6AL-4V (Ann.)	SCG	2.05	1.26	2.58

Table II (Cont'd)

WING SURFACE PANEL CONCEPT WEIGHT ESTIMATES
(CSS 140 - LOWER SURFACE)
(Con't)

Concept No.	Concept Description	Materials	Damage Mode	W Static	K_{σ}	Wt TOT
610-101	Integral Tee Stiffened	Ti 8-8-2-3	FS	1.73	1.00	1.73
610-101	Integral Tee Stiffened	Ti 8-8-2-3	SCG	1.73	1.64	2.84
610-105	Integral Blade	AL 7475-T7651	FS	2.44	1.00	2.44
610-105	Integral Blade	AL 7475-T7651	SCG	2.44	1.03	2.52
610-105	Integral Blade	Al 7475-T7651	FSH	2.44	1.13	2.76
610-105	Integral Blade	AL 7475-T7651	SCGH	2.44	1.13	2.76
610-105	Integral Blade	Ti 6AL-4V (Ann.)	FS	2.05	1.00	2.05
610-105	Integral Blade	Ti 6AL-4V (Ann.)	SCG	2.05	1.21	2.48
610-105	Integral Blade	Ti 6AL-4V (Ann.)	FSH	2.05	1.17	2.40
610-105	Integral Blade	Ti 6AL-4V (Ann.)	SCGH	2.05	1.21	2.48
610-105	Integral Blade	Ti 8-8-2-3	FS	1.72	1.00	1.72
610-105	Integral Blade	Ti 8-8-2-3	SCG	1.72	1.64	2.82
610-118	Integral Formed Bulb Tee	AL 7050-T76	FS	2.74	1.00	2.74
610-118	Integral Formed Bulb Tee	AL 7050-T76	SCG	2.74	1.24	3.40
610-118	Integral Formed Bulb Tee	Ti 6AL-4V	FS	2.05	1.00	2.05
610-118	Integral Formed Bulb Tee	Ti 6AL-4V	SCG	2.05	1.26	2.58
610-124	Hat Stiffened Skin	Ti 8-8-2-3	FS	1.75	1.00	1.75
610-124	Hat Stiffened Skin	Ti 8-8-2-3	SCG	1.75	1.64	2.87
610-124	Hat Stiffened Skin	Ti 6AL-4V (Ann.)	FS	2.05	1.00	2.05
610-124	Hat Stiffened Skin	Ti 6AL-4V (Ann.)	SCG	2.05	1.21	2.48

Table II (Cont'd)

WING SURFACE PANEL CONCEPT WEIGHT ESTIMATES
(CSS 140 - LOWER SURFACE)
(Con't)

	Concept No.	Concept Description	Materials	Damage Mode	W Static	K_σ	Wt TOT
	610-124	Hat Stiffened Skin	Ti 6AL-4V (Ann.)	SCGH	2.05	1.21	2.48
	610-124	Hat Stiffened Skin	AL 7050-T76	FS	2.48	1.00	2.48
	610-124	Hat Stiffened Skin	AL 7475-T761	FS	2.44	1.00	2.44
	610-124	Hat Stiffened Skin	Al 7475-T761	FSH	2.44	1.13	2.76
	610-124	Hat Stiffened Skin	AL 7475-T76	SCG	2.44	1.03	2.51
	610-124	Hat Stiffened Skin	AL 7475-T761	SCGH	2.44	1.13	2.76
	610-128	Honeycomb Sandwich Panels	AL 7050-T76	FS	2.52	1.00	2.52
	610-128	Honeycomb Sandwich Panels	AL 7050-T76	SCG	2.52	1.24	3.13
	610-128	Honeycomb Sandwich Panels	Ti 8-8-2-3	FS	1.95	1.00	1.95
	610-128	Honeycomb Sandwich Panels	Ti 8-8-2-3	SCG	1.95	1.64	3.20
*	610R-000	Sculptured Plate	AL 2024-T851	SCGH	2.50	1.70	4.25
*	610R-007	Full-Depth Core; Large Cell	Ti 8-8-2-3	SCG	2.20	1.64	3.16
*	610R-010	Honeycomb Panels-Composite Slugs	Ti 8-8-2-3	FS	1.87	1.00	1.87
*	610R-011	Honeycomb Panels-Channel Spar Splice	Ti 8-8-2-3	FS	1.74	1.00	1.74
*	610R-013B	Laminated Skin-Stepped Caps	AL 7050-T76	FS	2.30	1.00	2.30
*	610R-014	Full-Depth, Large Cell Core-Laminated Skin	Ti 8-8-2-3	FS	1.85	1.00	1.85
*	610R-015B	Welded Space Truss Sub	Ti 6-4 (Ann.)	FS	1.79	1.00	1.79

Table III

WING SURFACE PANEL CONCEPT WEIGHT ESTIMATES
(WING CSS 340 - LOWER SURFACE)

Concept No.	Concept Description	Materials	Wt TOT
610-016	Modified Triangular Truss Core	AL 7050-T76	0.24
610-016	Modified Triangular Truss Core	Ti 6AL-4V (Ann.)	0.33
610-021	Multiple Rectangular Tubes	Ti 6AL-4V (Ann.)	0.32
610-034	Triangular Truss Core	Ti 6AL-4V (Ann.)	0.35
610-034	Triangular Truss Core	AL 7050	0.24
610-101	Integral Tee Stiffeners	AL 7475-T7651	0.19
610-101	Integral Tee Stiffeners	Ti 6AL-4V (Ann.)	0.28
610-105	Integral Blade Stiffeners	AL 7475-T7651	0.21
610-105	Integral Blade Stiffeners	Ti 6AL-4V (Ann.)	0.32
610-124	Hat Stiffened Skin	AL 7050-T76	0.24
610-124	Hat Stiffened Skin	Ti 6AL-4V (Ann.)	0.33
610-128	Honeycomb Sandwich Panel	AL 7050-T76	0.27
* 610R-104	Baseline-Sculptured Plate	AL 2024-T851	0.49
* 610R-100	Honeycomb Sandwich Panels	AL 7050-T76	0.42
* 610R-102	Adhesive Bonded Multi-Spar	AL 7050-T76	0.18
* 610R-103	Honeycomb Sandwich Panels	Ti 6AL-4V (Ann.)	0.50
610-118	Integral Formed Bulb Tee	AL 7475	0.23

Table IV

WING SURFACE PANEL CONCEPT WEIGHT ESTIMATES
(WING CSS 340 - UPPER SURFACE)

Concept No.	Concept Description	Material	Wt TOT
610-016	Modified Triangular Truss Core	AL 7050-T76	0.29
610-021	Multiple Rectangular Tubes	Ti 6AL-4V STA	0.37
610-021	Multiple Rectangular Tubes	Ti 6AL-4V (Ann.)	0.38
610-034	Triangular Truss Core	Ti 6AL-4V (Ann.)	0.39
610-034	Triangular Truss Core	AL 7050	0.28
610-101	Integral Tee Stiffeners	AL 7050-T7651	0.26
610-101	Integral Tee Stiffeners	Ti 6AL-4V STA.	0.31
610-105	Integral Blade Stiffeners	AL 7050-T7651	0.30
610-105	Integral Blade Stiffeners	Ti 6AL-4V STA	0.37
610-105	Integral Blade Stiffeners	Ti 6AL-4V (Ann.)	0.38
610-124	Hat Stiffened Skin	AL 7050-T76	0.28
610-124	Hat Stiffened Skin	Ti 6AL-4V (Ann.)	0.32
610-128	Honeycomb Sandwich Panels	AL 7050-T76	0.27
610-200	Laminated Plates	AL 7050-T76	0.45
610-200	Laminated Plates	Ti 8-8-2-3	0.78
* 610R-104	Baseline - Sculptured Plate	2024-T851	0.62
* 610R-101	Full-Depth-Core Sandwich	Ti 6AL-4V STA.	0.22
* 610R-108	Full-Depth-Core Sandwich	Ti 8-8-2-3	0.28
* 610R-109	Multiple Tension Stra/Inte. Stiff.	Ti 6AL-4V (Ann.)	0.43
* 610R-100	Ribbon Truss Upr Surf Sandwich	AL 7050-T76	0.60

Table IV (Cont'd)

WING SURFACE PANEL CONCEPT WEIGHT ESTIMATES
(WING CSS 340 - UPPER SURFACE)
(Con't)

	Concept No.	Concept Description	Material	Wt TOT
*	610R-102	Adhesive Bonded Multi-Spar	AL 7050-T76	0.18
*	610R-103	Honeycomb Sandwich Panels	Ti 6AL-4V (Ann.)	0.49
	610-118	Integral Formed Bulb Tee	AL 7475	0.30

I.2.1.2 Manufacturing Evaluation

The evaluation of wing skin concepts was based on comparison to known industry standards. Charts were prepared to assess the relative difficulty of manufacturing and assembly. These charts are shown as Tables V and VI. Approximately eighty-eight (88) concepts were evaluated by the Manufacturing Engineers.

The higher the numbers shown in the chart, the easier the concept is to manufacture and assemble. The letter designations used in the charts are described on the second sheet of each.

I.2.1.3 NDI Evaluation

The NDI evaluations were also based on comparison to known standards. Each concept is evaluated and specific comments on inspectability is tabulated in Table VII. These concepts were intended to aid the designers by identifying problem areas.

I.2.2 Concept Utilization

Not all concepts generated during this initial portion of the program will be used. Those concepts which are included in the next step in the Design Approach, the Cross-Section Drawings, are identified and the drawings in which they are used are listed in Table VIII. Those concepts not used are also identified in Table VIII and the reasons for their cancellation are listed.

Table V

COMPRESSION SKINS

CONCEPT RATING

MANUFACTURING AND ASSEMBLY

DWG. NO.	CONCEPT	MATL.	100-75	75-50	50-25	25-0
610-000	AB-HC PANEL	A	▼			
-001	DB-EXP CORE	T				▼
-002	BEADED PANEL	AT				▼
-003	AB-HC PANEL		▼			
-004	AB-HC (WELD) PAN	T			▼	
-005	SS PANEL (MULTI)	AT	▼			
-006	SS PANEL (Z)	AT	▼			
-007	SS PANEL	AT		▼(A)	(T)▼	
-008	SS PANEL	AT	▼			
-009	AB-HC + SLUG PAN	AT	▼			
-010	AB-HC-NO SLUG-PAN	AT		▼		
-011	TRUSS-LATTICE-PAN	TS			▼(T) (S)▼	
-012	TRUSS-CORR-PAN	AT			▼	
-013	PYM CORE	ATS				▼
-014	STRESSKIN (WELD) PAN	TS		▼(T)		▼(S)
-015	EXP TRUSS CORE-B_Z	TS				▼
-016	ROLL DB-TRUSS PAN	T				
	AB-TRUSS PAN	A		▼		
-017	AB-HC-PLANK PAN	A	▼			
-018	STAMPED CORE-PAN	AT		(A)▼	(T)▼	
-019	B_Z PAN-SW CORE	TS			(T) (S)▼	
-020	AB-BULB STIFF	AT				(A) (T)
-021	T-BURN THRU PAN (TIG)	T			▼	
-022	AB-HC PANEL	A	▼			
-023	T-BURN THRU PAN (EB)	T			▼	
-024	AB-SQ TUBE PANEL	T			▼	
-025	T-BURN THRU PAN (EB)	T				▼
-026	O-TUBE PAN-EB	AT			▼	
-027	AB-SQ TUBE + 1 + SKINS	T				▼
-028	AB-HC-ELG CORE	AT		▼		
-029	TRI-TRUSS-AB PAN	AT			(A)▼	▼(T)
-030	RIBBON CORE	AT			▼	
-031	WAFFLE GRID	AT	▼(A) ▼(T)			
-032	Y-STRINGER-PAN	T		▼		
-033	CORR-PANEL	AT		▼		
-034	45^{o} TRUSS T-BURN	ATS		▼		
-035	AB-HC CONST. TAPER	ATS		▼		
-036	T-BURN Y STIFR	TS			▼	

▼

Table VI

TENSION SKINS

CONCEPT RATINGS

MANUFACTURING AND ASSEMBLY

DWG. NO.	CONCEPT	MATL	100-75	75-50	50-25	25-0
610-100	AB-BEADED-LAMIN	AT		(A)▼	▼(T)	
-101	CSDB-T STIFFENER	T			▼	
-102	CSDB-BD STIF + SPAR	T				▼
-103	STRESS SKIN-DB+EB	T				▼
-104	RDB-T STIFFENER	T			▼	
-105	FORGE/MACH-PLANKS	AT		▼(A)	▼(T)	
-106	PLANK-LAMINATE	AT	▼			
-107	PLANK-MACHINED	AT	▼			
-108	PLANK-SPLICED	AT	▼			
-109	AB-HC+DB STIF	T				▼
-110	AB-HC+DB SLUG	T			▼	
-111	AB-HC+SP CP-LAM SKIN	AT		▼		
-112	BZ-HC+SPAR CAP	TS			▼	

Table VI (CONT'D)
TENSION SKINS
CONCEPT RATINGS

MANUFACTURING AND ASSEMBLY

DWG. NO.	CONCEPT	MATL	100-75	75-50	50-25	25-0
610-113	BZ-SLUG + SPAR CAP	TS			▼	
-114	INT. STIF PAN-AB/BZ/DB	TS	▼(AB)	(Bz) ▼	▼(DB)	
-115	BZ SP CP + HC/COMP	T B/G			▼	
-116	AB INT STIF-B-LAM	AT B/G		▼		
-117	TI-B/G COMPOSITE	T B/G		▼		
-118	AB-INT STIF-BULB	ATS	(A) ▼		▼(T-S)	
-119	AB-HC PAN-SKIN-SPR	AT			▼	
-120	AB-LAM + WB	AT	▼			
-121	AB-LAM-IS-TAPER	AT		(A)▼(T)▼		
-122	BZ HC + SPAR CAP	T			▼	
-123	BZ/AB LAM (T & S)	TS				▼

Table VI (CONT'D)
TENSION SKINS
CONCEPT RATINGS

DWG NO.	CONCEPT	MATL	100-75	75-50	50-25	25-0
610-124	AB-HAT-SPAR LAM	AT	▼			
-125	AB-HC + COMP SLUG	TG		▼		
-126	AB-HC-RIBBONS	ATS			▼	
-127	AB-HC + HC SPAR	T			▼	
-128	AB-HC + LAM SPAR	T		▼		
-129	SPAR SKIN-T BURN + COMP	TS				▼
-130	AB/BZ-HC + TI SLUG	TS	(AB)▼		▼(Bz)	
-131	EX-PLANK + SPAR	AT		▼(A) ▼(T)		
-132	AB-LAM + SPAR	AT	▼			
-133	BZ-FULL DEPTH DIAG.	TS				▼

AB-ADHESIVE BOND A-ALUMINUM
DB-DIFFUSION BOND T-TITANIUM
SS-SKIN STRINGER S-STEEL
HC-HONEYCOMB

Table VII

NDI COMMENTS

DRAWING NO.	NDI COMMENT
610-000	o Easily inspected. o Existing NDI techniques may be adaptable. o Steps, core splices. 2 core materials may increase inspection costs.
610-001	o Very difficult to inspect. New technology required.
610-002	o Easily inspected. Existing techniques may be adapted.
610-003	o Easily inspected. Existing technology may be adapted. Taper, Lazy "Z", double core uses increase inspection costs.
610-004	o Some difficulty in inspection. Existing techniques may be adapted for bonded areas.
610-005	o Fastener hole concepts very easy to inspect during manufacture. Difficult field inspection. o Adhesive bonds or brazed joints easily inspected. New technology required. o Some difficulty in inspecting welds, spot welds and weld bonds.
610-008	o Some difficulty in inspecting welded joints.
610-009	o Easily inspected except around hole. Existing techniques may be adaptable.
610-010	o Easily inspected except around hole. Existing bonding inspection techniques may be adaptable.
610-011	o Difficult to inspect. New technology.
610-012	o Difficult to inspect. New technology for diffusion bonds.
610-013	o Extremely difficult to inspect.
610-014	o Easily inspected except welds.
610-015	o Difficult to inspect after expansion.
610-016	o Easily inspected for adhesive bond. Diffusion bonds require new technology.
610-017	o Easily inspected. Existing NDI may be adapted for core area. Tapers, joggle, double core increase inspection costs and difficulty.
610-018	o Very difficult to inspect.
610-019	o Some inspection difficulty.
610-020	o Extremely difficult and costly to inspect.
610-021	o Some inspection difficulty for "T" configuration.
610-022	o Easily inspected except joggle and core splice.
610-023	o Same as 610-021.
610-024	o Outer surfaces easily inspected.

Table VII (Cont'd)

DRAWING NO.	NDI COMMENT
610-025	o Tube joint inspection would be difficult and costly.
610-026	o Extremely difficult to inspect tube node welds. o Some difficulty in inspecting skin-to-tube welds.
610-027	o Same as 610-024.
610-028	o Some inspection difficulty.
610-029	o Easily inspected.
610-030	o Weld bond inspection is difficult and costly. o Outer surface easily inspected.
610-031	o Easily inspected. Existing techniques apply.
610-032	o Easily inspected.
610-033	o Some inspection difficulty.
610-034	o Some inspection difficulty.
610-100	o Some NDI difficulty.
610-101	o Some difficulty in inspection. Diffusion bonds require new NDI technology.
610-102	o Easily inspected except spar joint and welds.
610-103	o Sandwich panel easily inspected. Diffusion bonds and welds difficult to inspect.
610-104	o Difficult to inspect.
610-105	o Existing NDI applies.
610-106	o Existing NDI applies. Field inspection difficult.
610-107	o Existing NDI applies.
610-108	o Existing NDI applies.
610-109	o Adhesive bonds easily inspected. o Diffusion bonds very difficult to inspect.
610-110	o Adhesive bonds easily inspected. o Diffusion bonds very difficult to inspect.
610-111	o Some difficulty in inspecting.
610-112	o Some inspection difficulty.
610-113	o Some inspection difficulty.
610-114	o Adhesive bond easily inspected. o Brazing or diffusion bond requires NDI development.
610-115	o Very difficult to inspect. Extensive development required.
610-116	o Very difficult to inspect.
610-117	o Very difficult to inspect.
610-118	o Some inspection difficulty.
610-119	o Some inspection difficulty. Costly.

Table VII (Cont'd)

DRAWING NO.	NDI COMMENT
610-120	o Very difficult inspection, new technology required.
610-121	o Some inspection difficulty.
610-122	o Very difficult to inspect. New technology required.
610-123	o Some inspection difficulty. New technology.
610-124	o Some inspection difficulty. Taper may increase inspection costs.
610-125	o Very difficult to inspect. o May not be able to inspect for fiber continuity.
610-126	o Some inspection difficulty. New technology.
610-129	o Very difficult to inspect. New technology.
610-130	o Very difficult to inspect. New technology.
610-131	o Very easy to inspect. Existing technology applies.
610-132	o Some inspection difficulty. Stepped configuration increases inspection costs.
610-200	o See 610-005 for NDI.
610-201	o Easily inspected except welds.
610-202	o See 610-005 for NDI evaluation.
610-203	o Some difficulty in inspecting multilayers.
610-204	o Easily inspected. See 610-005 for joint NDI.
610-205	o Core area easily inspected. o Some difficulty in inspecting tapers, diffusion bonds.
610-206	o Extremely difficult to inspect.
610-207	o Very difficult to inspect.
610-208	o Very difficult to inspect.
610-209	o Easily inspected except tapers.
610-210	o Easily inspected. Existing NDI may be adaptable.
610-211	o Some inspection difficulty.
610-212	o Liner-shim bond easily inspected. Stiffener tube joint extremely difficult to inspect.
610-213	o Extremely difficult to inspect.
610-214	o Extremely difficult to inspect.
610-215	o Some difficulty in inspecting.
610-216	o Some difficulty in inspection.
610-300	o Some inspection difficulty.
610-301	o Very difficult and costly to inspect. New technology.
610-302	o Some inspection difficulty.
610-303	o Some inspection difficulty. New technology.
610-304	o Some inspection difficulty. Bonded joints cannot be 100% inspected.

Table VII (Cont'd)

DRAWING NO.	NDI COMMENT
610-305	o Extremely difficult to inspect bonds. o Some difficulty in inspecting welds.
610-306	o Easily inspected.
610-307	o Easily inspected.
610-308	o Inspection requirements unknown.
610-400	o Existing NDI applies. Disassembly required for 100% field NDI.
610-402	o Easily inspected.
610-403	o Some difficulty in inspecting closure ship area.
610-500	o Easily inspected. Existing NDI may apply. o Diffusion bonds/molds very difficult to inspect.
610-501	o Some inspection difficulty.
610-502	o Some difficulty in inspecting truss members.
610-600	o Difficult weld inspection.
610-601	o Some inspection difficulty.
610-700	o Very difficult to obtain 100% inspection.
610-701	o Very difficult to obtain 100% inspection.
610-702	o Some difficulty in inspecting.
610-703	o Concept (1) very difficult to obtain 100% inspection. o Some difficulty in inspecting concept (2).
610-704	o Total NDI of joint is impracticable.
610-705	o Some inspection difficulty.

Table VIII ELEMENT CONCEPT UTILIZATION

CONCEPT NO.	NDI RATING*	MFG RATING**	USED IN DWG. NO.	NOT USED IN FUTURE WORK FOR FOLLOWING REASONS
610-000	A	85	610R-001,-117	
-001	C	10		Manufacturing and tooling costs excessive
-002	A	20		Manufacturing and tooling costs excessive
-003	A	85	610R-011	
-004	B	45	610R-010	
-005	B	95		Not as efficient as continuous corrugation or other stiffening methods
-006	B	90		Same as 610-005
-007	B	70		Same as 610-005
-008	B	95	610R-002,-022, -025	
-009	B	80	610R-004	
-010	B	70	610R-004	
-011	C	50	610R-100	
-012	C	50	610R-116	
-013	D	15		Pyramid core will not compete with honeycomb on cost or weight
-014	B	65		Manufacturing costs excessive

*A = Easy to Inspect, B = Normal Difficulty in Inspection, C = Difficult to Inspect, D = Hard to Inspect, E = Impossible

**Based on 0 to 100. 0 is impossible to manufacture, 100 is easy to manufacture.

Table VIII (Cont'd) ELEMENT CONCEPT UTILIZATION

CONCEPT NO.	NDI RATING*	MFG RATING**	USED IN DWG. NO.	NOT USED IN FUTURE WORK FOR FOLLOWING REASONS
610-015	C	5		Extremely difficult to manufacture without stretching core material
-016	C	65	610R-026,-110, -114	
-017	A	80		Splices to achieve fail safety not required in upper surface
-018	C	65		Structurally inefficient
-019	B	40		Structurally inefficient
-020	D	20	610R-006	
-021	B	40	610R-017,-111	
-022	B	90		Splices to achieve fail safety not required in upper surface
-023	B	30	610R-005	
-024	A	40	610-021	
-025	C	5	610-021	
-026	D	35		Manufacturing costs excessive
-027	A	15	610R-003	
-028	B	65		Small weight savings potential does not warrant excessive costs

Table VIII (Cont'd) ELEMENT CONCEPT UTILIZATION

CONCEPT NO.	NDI RATING*	MFG RATING**	USED IN DWG. NO.	NOT USED IN FUTURE WORK FOR FOLLOWING REASONS
-029	A	45	610R-105	
-030	C	30		Same as 610-028
-031	A	90	610R-106	
-032	A	70	610R-002, -018	
-033	B	55	610-034	
-034	B	60	610R-020,-024, -026, -110, -114	
610-035		65	610R-012,-107	
-036		45	610R-018	
610-100	B	60	610R-004	
-101	C	35	610R-021, -115	
-102	B	20		Manufacturing costs excessive
-103	C	15		Manufacturing costs excessive
-104	C	30	610R-021	
-105	A	60	610R-001, -003	
-106	B	95	610R-001	
-107	A	90		Inefficient joint

Table VIII (Cont'd) **ELEMENT CONCEPT UTILIZATION**

CONCEPT NO.	NDI RATING*	MFG RATING**	USED IN DWG. NO.	NOT USED IN FUTURE WORK FOR FOLLOWING REASONS
-108	A	88	610R-003	
-109	C	20		Manufacturing costs excessive; unreliable NDI
-110	C	35		Same as 610-109
-111	B	55	610-127	
-112	B	35	610R-006	
-113	B	30	610R-009	
-114	C	75	610R-001	
-115	D	35		Excessive costs; composites too expensive
-116	D	55		Same as 610-115
-117	D	50		Same as 610-115
-118	C	60	610R-009, -109	
-119	C	45	610R-100	
-120	D	85		Difficult to inspect; unreliable
-121	C	60		Manufacturing costs excessive
-122	D	30		Manufacturing costs excessive
-123	C	15		Manufacturing costs excessive
-124	C	90	610R-002, -022, -025	

Table VIII (Cont'd) ELEMENT CONCEPT UTILIZATION

CONCEPT NO.	NDI RATING*	MFG RATING**	USED IN DWG. NO.	NOT USED IN FUTURE WORK FOR FOLLOWING REASONS
-125	D	55	610R-010	
-126	C	35		Manufacturing costs excessive
-127		45	610-128	
-128		55	610R-005, -011 -013, -027, -028, -029	
-129	D	20		Manufacturing costs excessive
-130	D	65		Manufacturing costs excessive
-131	A	65	610R-001	
-132	C	80	610R-001, -013	
-133		10	610R-007, -101	
610-200	B		610R-002	
-201	B		610R-009	
-202	B			Not directly applicable to cross-section designs
-203	B		610R-006	
-204	A		610R-004	
-205	B			Same as 610-109
-206	D			Manufacturing costs excessive

Table VIII (Cont'd) ELEMENT CONCEPT UTILIZATION

CONCEPT NO.	NDI RATING*	MFG RATING**	USED IN DWG. NO.	NOT USED IN FUTURE WORK FOR FOLLOWING REASONS
-207	D			Manufacturing costs excessive
-208	D		610R-029	
-209	B		610R-010	
-210	A		610R-109	
-211	B			Manufacturing costs excessive
-212	D			Manufacturing costs excessive
-213	D		610-214	
-214	D		610R-010, -103	
-215	C			Manufacturing costs excessive
-216	C			Structurally inefficient
-217	B			Structurally inefficient
-218	D		610R-008, -015	
-219	B		610R-003	
-220	B		610R-106	
-221			610R-006, -012 -017, -020, -024	
610-300	B			Manufacturing costs excessive

Table VIII (Cont'd) ELEMENT CONCEPT UTILIZATION

CONCEPT NO.	NDI RATING*	MFG RATING**	USED IN DWG. NO.	NOT USED IN FUTURE WORK FOR FOLLOWING REASONS
-301	D		610R-103	
-302	B			Same as 610-216
-303	C			Difficult to form; manufacturing costs expensive
-304	C			Incompatible with hard point requirements
-305	D			Manufacturing costs excessive
-306	A			Same as 610-216
-307	A			Same as 610-216
-308	C		610R-009	
610-400	A			Not applicable to cross-section sketches - may be used in Analytical Assemblies or in Preliminary Design Phase
-401				Same as 610-400
-402	A			Same as 610-400
-403	B			Same as 610-400
-404				Same as 610-400
-405				Same as 610-400
610-500	A			Same as 610-400
-501	B			Same as 610-400

Table VIII (Cont'd) ELEMENT CONCEPT UTILIZATION

CONCEPT NO.	NDI RATING*	MFG RATING**	USED IN DWG. NO.	NOT USED IN FUTURE WORK FOR FOLLOWING REASONS
-502	B			Same as 610-400
610-600	C			Same as 610-400
-601	B			Same as 610-400
610-700	D			Same as 610-400
-701	D			Same as 610-400
-702	C			Same as 610-400
-703	D			Same as 610-400
-704	E			Same as 610-400
-705	B			Same as 610-400

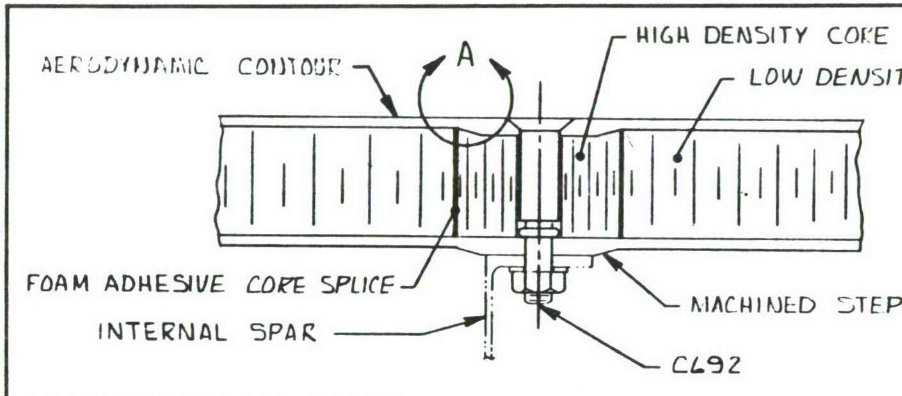
SECTION I.3

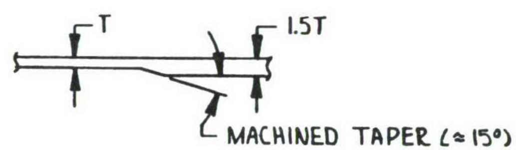
CATALOG OF

ELEMENT CONCEPT SKETCHES

COMPRESSION SKIN CONCEPTS

SKETCHES 610-000 THROUGH 610-036





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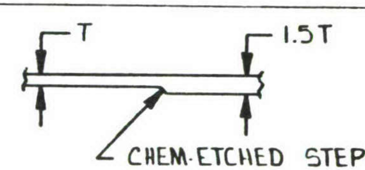

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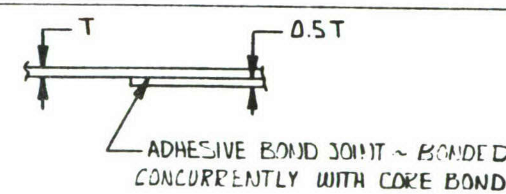

ALTERNATE DETAIL A

STRUCTURAL CONCEPT 610-000

TITLE SKIN, CONSTANT DEPTH SANDWICH, I

CONCEPT DESCRIPTION ADHESIVE BONDED [illegible] DEPTH SANDWICH PANEL. HIGH DENSITY CORE AT SPARS AND RIBS. SKINS MACHINED PRIOR TO BONDING (EXCEPT 2nd ALTERNATE).

APPLICATION
COMPRESSION SKIN

MATERIALS CORE ~ 5056 ALUMINUM (PODS)
SKINS ~ 2124 ALUMINUM

LOAD RANGE

CONCEPT FEATURES

ADVANTAGES ~

1. GOOD STABILITY
2. LIGHT WEIGHT
3. REDUNDANT LOAD PATHS
4. SIMPLE EDGE MEMBERS
5. PROVEN TECHNOLOGY

DISADVANTAGES ~

1. BOLT BENDING
2. COST TO MANUFACTURE

SOURCE ~ EXISTING TECHNOLOGY

PREPARED BY [signature] **DATE** 6/9/72

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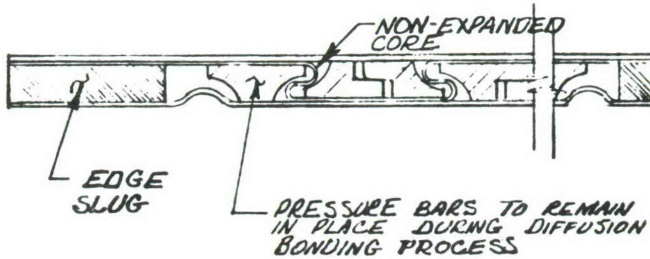
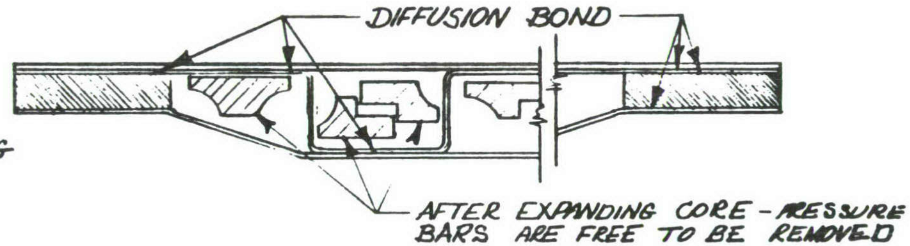
Fort Worth Operation

- PANEL CONFIG BEFORE EXPANDING CORE



- AFTER DIFFUSION BONDING - PANEL WILL BE PLACED BETWEEN TWO FIXED FLAT PLATENS & CORE EXPANDED BY APPLICATION OF INTERNAL PRESSURE TO PRODUCE FULL THICKNESS PANEL AND ALLOW REMOVAL OF PRESSURE BARS

- PANEL CONFIG. AFTER EXPANDING CORE



STRUCTURAL CONCEPT

610-001

TITLE SKIN- SANDWICH, DIFFUSION BONDED PRESSURE EXPANDED - CORRUGATED CORE

CONCEPT DESCRIPTION SANDWICH WITH DIFFUSION BONDED PRESSURE EXPANDED - CORRUGATED CORE IS A CONCEPT THAT PROVIDES A DIFFUSION BOND BETWEEN FACE SHEETS AND CORE WITHOUT PROBLEM OF PRESS BAR REMOVAL

APPLICATION
- AIRFRAME SKINS
- SHEAR & PRESSURE BHDS.

MATERIALS
TITANIUM ALLOYS

LOAD RANGE AXIAL: 1000 TO 25,000 #/in
SHEAR — 500 - 15,000 #/in

CONCEPT FEATURES ADVANTAGES:
- HIGH TEMP CAPABILITY
- BOND STRENGTH BETWEEN CORE & SKIN EQUAL TO PARENT METAL STRENGTH
- PANEL CAN BE SHEAR RESISTANT TO ULT. LOAD
- HIGH LOCAL STABILITY FOR COMPRESSION LOADING

DISADVANTAGES:
- WILL NOT CARRY BENDING MOMENT ⊥ TO CORE WEBS

PREPARED BY R.W. McCarthy | DATE 6-9-72

GENERAL DYNAMICS
Convair Aerospace Division
Fort Worth Operation

STRUCTURAL CONCEPT 610-002

TITLE SKIN ~ ROLL BONDED/EXPLOSIVE BEADED

CONCEPT DESCRIPTION ROLL BONDED/EXPLOSIVE BEADED SKIN PANEL CONSISTS OF ROLL BOND JOINING TWO SHEETS IN SPECIFIED AREAS & EXPLOSIVE FORMING THE REMAINING AREA INTO BEADS TO PRODUCE DESIRED STIFFENERS

APPLICATION
- OUTER WING SKIN PANELS
- SPAR SHEAR WEBS
- RIB SHEAR WEBS

MATERIALS
- CLAD ALUMINUM ALLOYS
- TITANIUM ALLOYS

LOAD RANGE 100 – 20,000 #/IN AXIAL CAPABILITY
100 – 15,000 #/IN SHEAR FLOW

CONCEPT FEATURES
- HIGH TEMP CAPABILITY
- BOND STRENGTH BETWEEN INNER & OUTER SKINS EQUAL TO PARENT METAL
- PANEL CAN BE SHEAR RESISTANT TO NEAR ULTIMATE LOAD
- WILL PERFORM MORE EFFICIENTLY AS A SHEAR PANEL THAN AN AXIAL LOAD MEMBER – USING A THICK OUTER SKIN – THIN INNER SKIN WILL IMPROVE EFFICIENCY AS A COMPRESSION MEMBER.

PREPARED BY R.W. McAnally DATE 6-8-72

GENERAL DYNAMICS
Convair Aerospace Division
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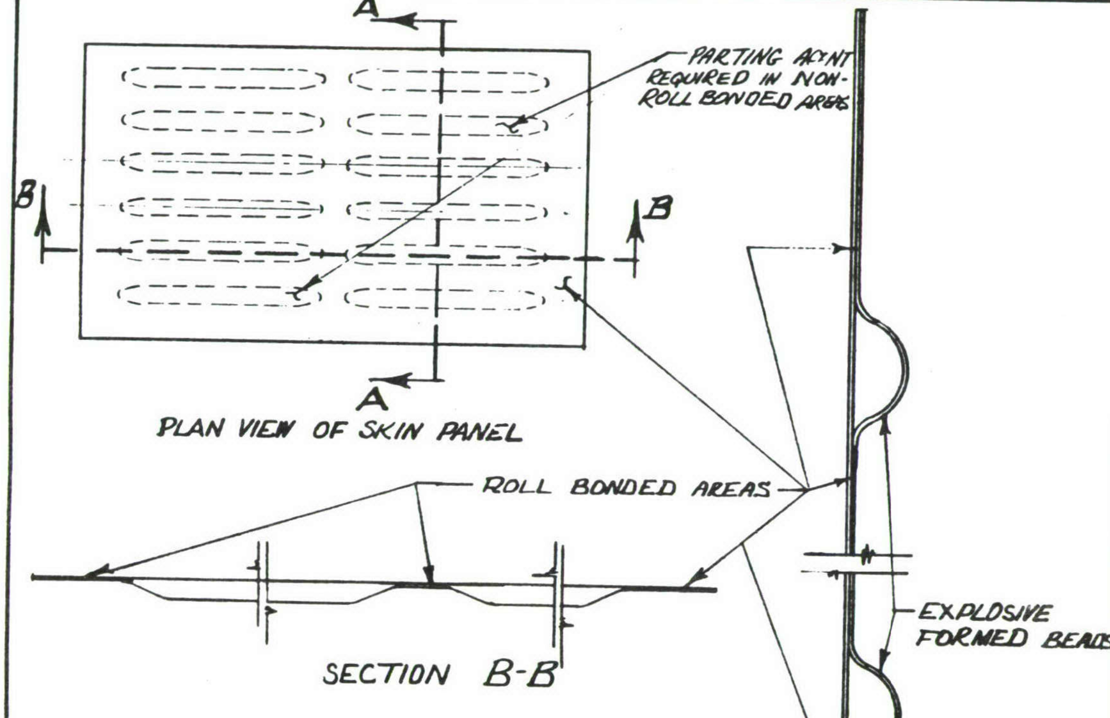
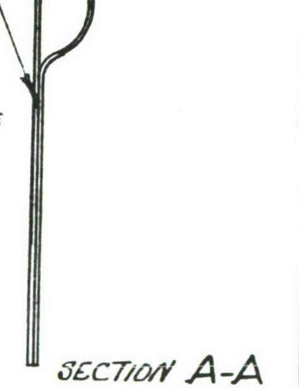
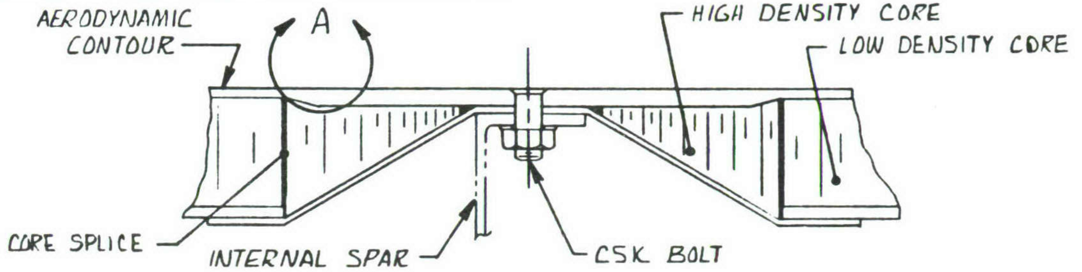
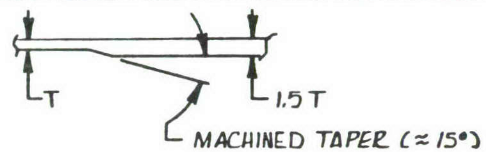




NOTE: EXPLOSIVE CONFIGURATION WILL REQUIRE DEVELOPMENT ~ SOLID EXPLOSIVES REQUIRING HIGH TEMP DETONATION LAYED INTO PANEL BEFORE ROLL BONDING, THEN DETONATED WHILE PANEL IS IN DIE MAY PRODUCE DESIRED RESULTS. LIQUID EXPLOSIVES PUMPED INTO NON-BONDED AREAS AFTER ROLL-BONDING THEN DETONATED WITH PANEL IN DIE MAY WORK

ALTERNATE FABRICATION METHOD:
- PRE-FORM BEADED SKIN BEFORE DIFFUSION BONDING
- ROLL BOND BEADED SKIN TO FLAT SKIN BY ROLLING IN TWO DIRECTIONS WITH ROLLS DESIGNED TO CONTACT SKINS IN FLAT AREAS BETWEEN BEADS





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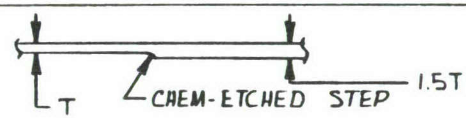
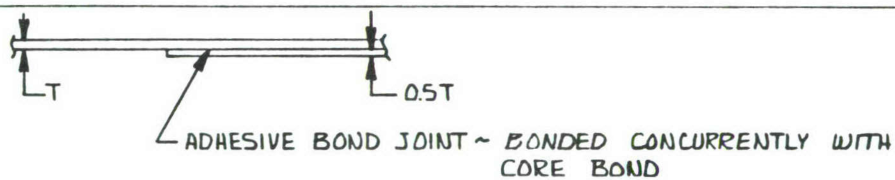


ALTERNATE DETAIL A



ALTERNATE DETAIL A

STRUCTURAL CONCEPT 610-003

TITLE SKIN, SANDWICH WITH ZEE EDGE MEMBER

CONCEPT DESCRIPTION ADHESIVE BONDED PANEL. NO CORE AT SPARS AND RIBS. ZEE EDGE MEMBERS OVER HIGH DENSITY CORE. SKIN MACHINED PRIOR TO BONDING (EXCEPT 2nd ALTS)

APPLICATION
COMPRESSION SKIN

MATERIALS CORE ~ 5056 ALUMINUM (P006)
SKIN ~ 2124 ALUMINUM OR TITANIUM

LOAD RANGE

CONCEPT FEATURES
ADVANTAGES ~
1. GOOD STABILITY
2. LIGHT WEIGHT
3. REDUNDANT LOAD PATHS

DISADVANTAGES ~
1. CORE MACHINING
2. COST TO MANUFACTURE

SOURCE ~ EXISTING TECHNOLOGY

PREPARED BY J. D. Birler | DATE 6/12/72

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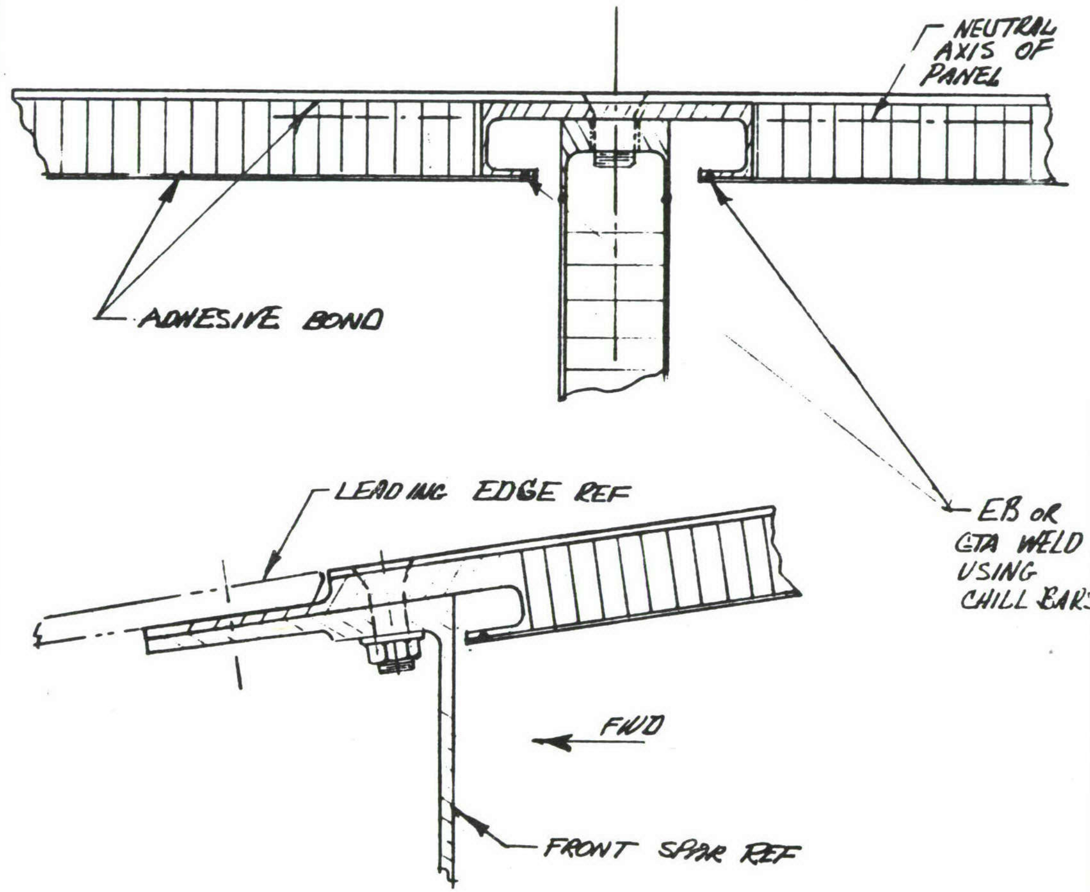

STRUCTURAL CONCEPT 610-004

TITLE SKIN~SANDWICH BONDED HONEY COMB - WELD SEALED EDGES

CONCEPT DESCRIPTION CONCEPT IS CONVENTIONAL ADHESIVE BONDED HONEY COMB SANDWICH WITH EDGE AND SLUG MEMBERS CONFIGURED TO REDUCE CROSS SECTION & PERMIT WELD SEAL OF EDGES

APPLICATION COMPRESSION SKIN.-

MATERIALS TITANIUM

LOAD RANGE 1000 - 25000# IN AXIAL LOAD

CONCEPT FEATURES

- INCORPORATES WELD SEALED EDGES.
- SLUG MEMBERS CAN BE OF MIN CROSS-SECTION REQD.
- WITH THICK OUTER SKIN & THIN INNER SKIN, SLUG CONFIGURATION WILL PERMIT SPAR/SKIN JOINT TO FALL ON NEUTRAL AXIS OF PANEL

PREPARED BY [signature] DATE 6/12/72

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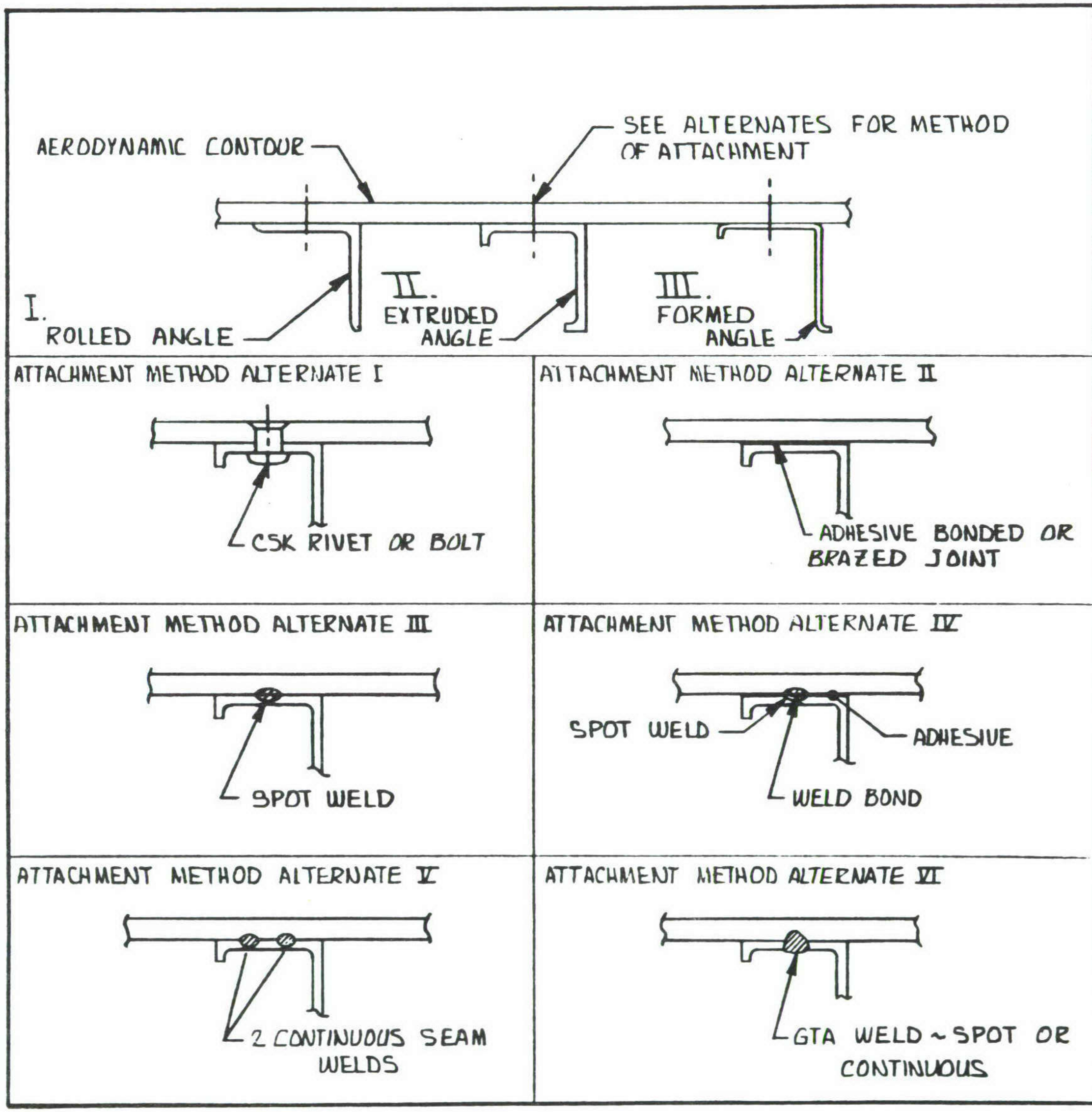


STRUCTURAL CONCEPT 610-005

TITLE SKIN, STIFFENED WITH ANGLE

CONCEPT DESCRIPTION PLATE SKIN STIFFENED WITH ANGLE SHAPE. ALTERNATE METHODS OF ATTACHMENT SHOWN. THREE METHODS OF ANGLE MANUFACTURE SHOWN.

APPLICATION
COMPRESSION SKIN

MATERIALS ALUMINUM OR TITANIUM

LOAD RANGE

CONCEPT FEATURES

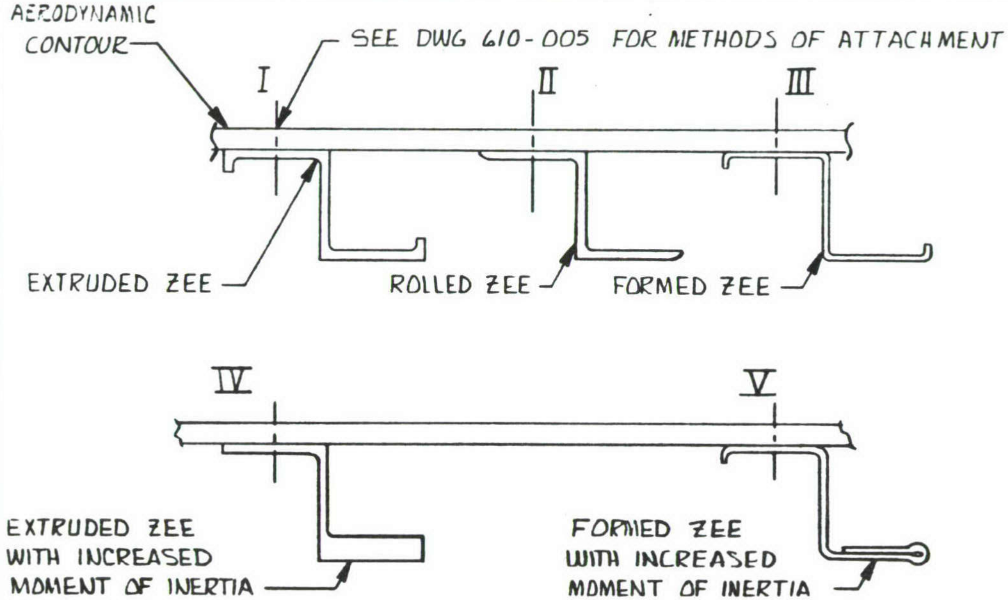
ADVANTAGES ~
1. MINIMIZES MACHINING OF PLATE
2. STIFFNESS CAN BE TAILORED BY SPACING.
3. EASY TO AUTOMATE MANUFACTURING

DISADVANTAGES
1. ALTERNATE I REQUIRES MANY HOLES.
- COST TO DRILL
- COST TO INSPECT
- SEALING OF FUEL

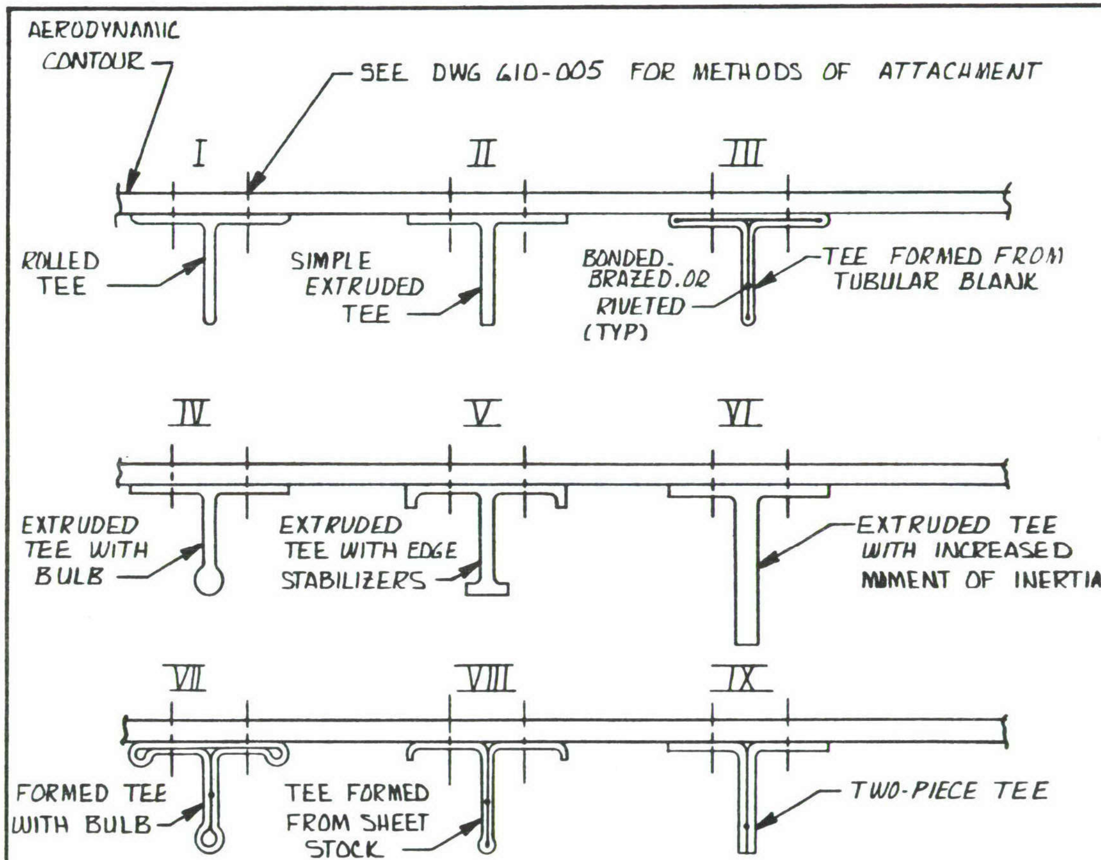
SOURCE ~ EXISTING TECHNOLOGY

PREPARED BY J D Bixler DATE 6/12/72

GENERAL DYNAMICS
Convair Aerospace Division
Fort Worth Operation



STRUCTURAL CONCEPT	610-006
TITLE SKIN, STIFFENED WITH ZEE	
CONCEPT DESCRIPTION PLATE SKIN STIFFENED WITH ZEE SHAPE. FIVE METHODS OF ZEE MANUFACTURE SHOWN.	
APPLICATION COMPRESSION SKIN	
MATERIALS ALUMINUM OR TITANIUM	
LOAD RANGE	
CONCEPT FEATURES ADVANTAGES ~ 1. SAME AS DWG 610-005 2. PROVIDES MORE STIFFNESS THAN ANGLE DISADVANTAGES ~ 1. SAME AS DWG 610-005 SOURCE ~ EXISTING TECHNOLOGY	
PREPARED BY J. D. Bixler	DATE 6/12/72
GENERAL DYNAMICS Convair Aerospace Division Fort Worth Operation	



STRUCTURAL CONCEPT 610-007

TITLE SKIN. STIFFENED WITH TEE

CONCEPT DESCRIPTION PLATE SKIN STIFFENED WITH TEE SHAPE. NINE METHODS OF TEE MANUFACTURE SHOWN.

APPLICATION
COMPRESSION SKIN

MATERIALS
ALUMINUM OR TITANIUM

LOAD RANGE

CONCEPT FEATURES

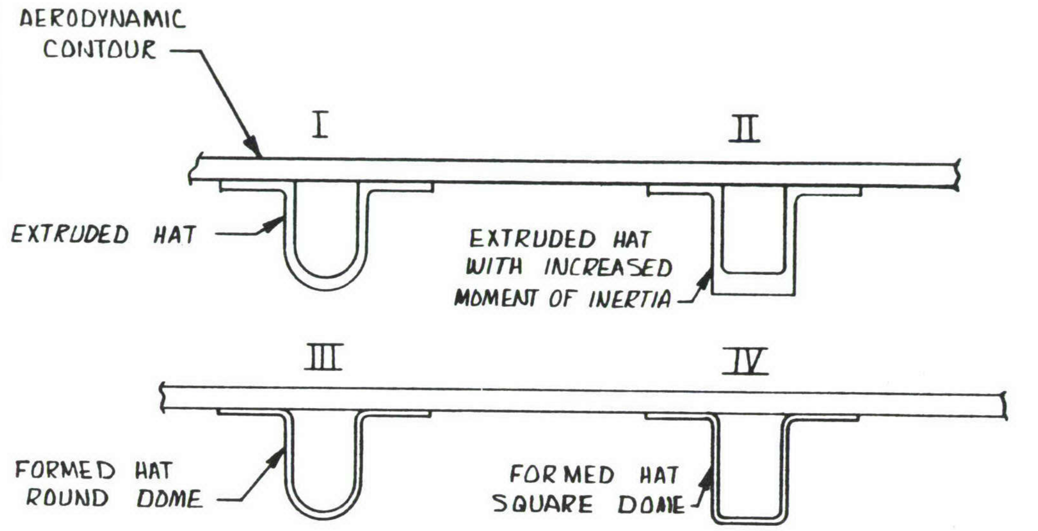
ADVANTAGES ~
1. SAME AS DWG 610-005
2. SYMETRICAL TRANSFER OF LOAD

DISADVANTAGES ~
1. SAME AS DWG 610-005

SOURCE ~ EXISTING TECHNOLOGY

PREPARED BY J.D. Bixler DATE 6/12/72

GENERAL DYNAMICS
Convair Aerospace Division
Fort Worth Operation



ATTACHMENT METHODS ~ REF DWG 610-005

METHOD I - CSK RIVET OR BOLT ~ THIS METHOD NOT TO BE USED WITH HAT SECTIONS. (FUEL SEALING PROBLEMS)

METHOD II - ADHESIVE BONDED OR BRAZED JOINT ~ CLEAN-UP OF FLUX A PROBLEM.

METHOD III - SPOT WELD ~ O.K.

METHOD IV - WELD BOND ~ O.K.

METHOD V - 2 CONTINUOUS SEAM WELDS ~ O.K.

METHOD VI - GTA WELD ~ O.K.

STRUCTURAL CONCEPT	610-008

TITLE SKIN, STIFFENED WITH HAT SECTIONS

CONCEPT DESCRIPTION PLATE SKIN STIFFENED WITH HAT SECTIONS. FOUR METHODS OF HAT MFG SHOWN.

APPLICATION
COMPRESSION SKIN

MATERIALS
ALUMINUM OR TITANIUM

LOAD RANGE

CONCEPT FEATURES

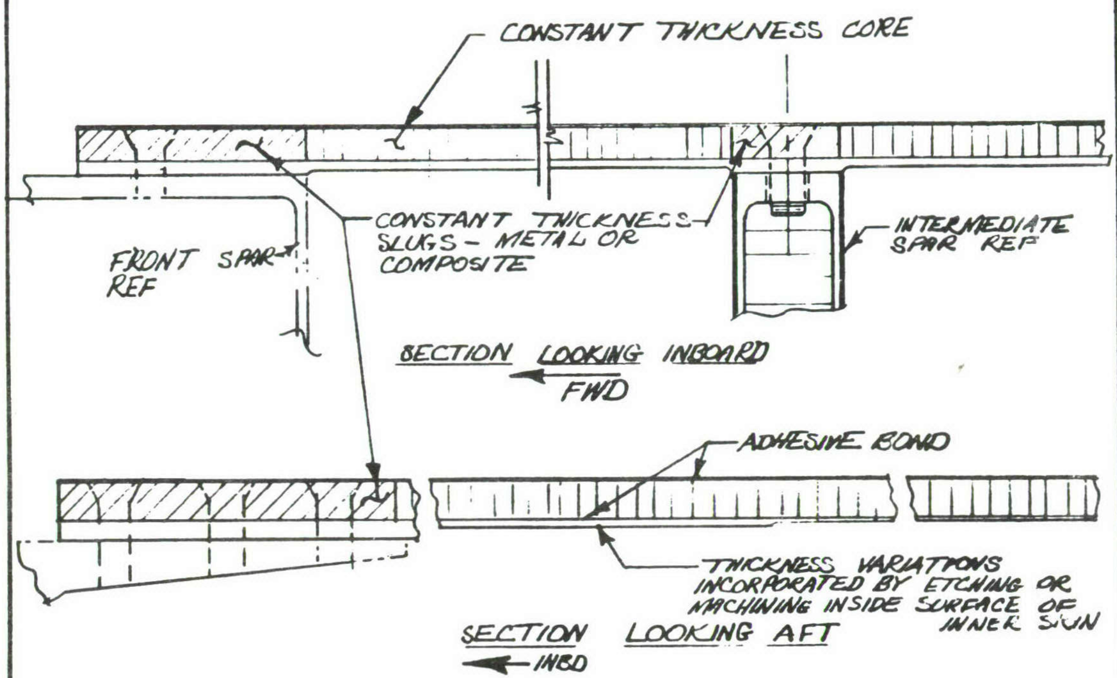
ADVANTAGES ~
1. SAME AS DWG 610-005 AND 610-007

DISADVANTAGES ~
1. SAME AS DWG 610-005
2. REDUCES FUEL CAPACITY

SOURCE ~ EXISTING TECHNOLOGY

PREPARED BY J.D. Bixler DATE 6/12/72

GENERAL DYNAMICS
Convair Aerospace Division
Fort Worth Operation



STRUCTURAL CONCEPT 610-009

TITLE SKIN ~ SANDWICH, CONSTANT THICKNESS CORE & SLUGS

CONCEPT DESCRIPTION ADHESIVE BONDED SANDWICH CONCEPT HOLDS CORE & SLUGS CONSTANT THICKNESS & VARIES THICKNESS OF INNER SKIN BY REMOVING METAL ON OUTSIDE SURFACE OF INNER SKIN.

APPLICATION OUTER SKIN WITH HIGH COMPRESSION LOAD.

MATERIALS TITANIUM OR ALUMINUM

LOAD RANGE 1000 - 25,000#/in AXIAL LOAD

CONCEPT FEATURES ADVANTAGES:

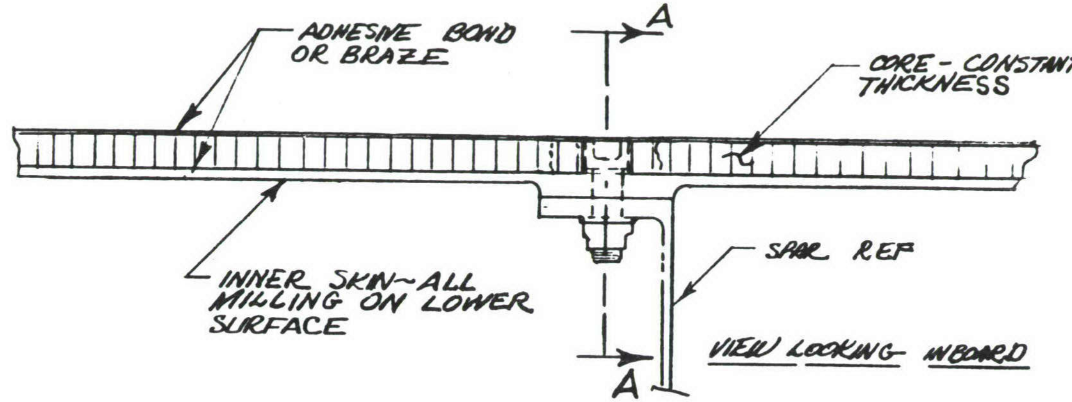
- PANEL FABRICATION WILL BE SIMPLIFIED BY HAVING CONSTANT THICKNESS CORE & SLUGS & DOING ALL MACHINING ON ONE PART ONLY
- PANEL WILL HAVE GOOD SHEAR & COMPRESS STABILITY.

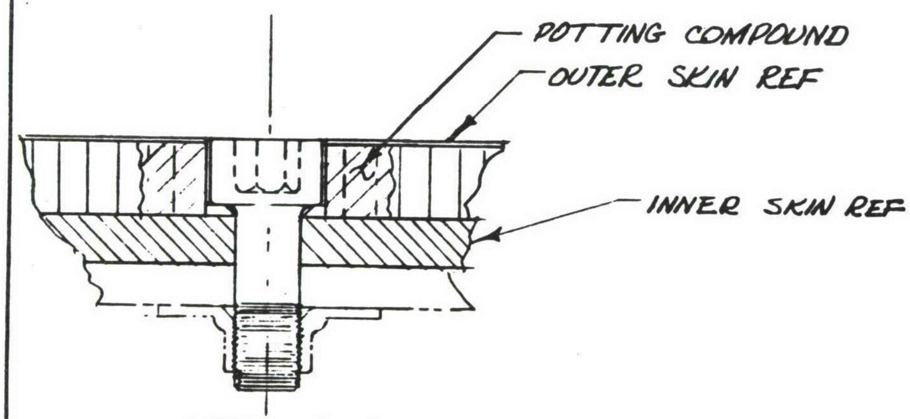
DISADVANTAGES

- HAVING THE INNER SKIN THICKER THAN OUTER SKIN WILL REDUCE OVER ALL MOMENT OF INERTIA FOR WING BENDING

PREPARED BY [signature] DATE 6-12-72

GENERAL DYNAMICS
Convair Aerospace Division
Fort Worth Operation





SECT A-A

STRUCTURAL CONCEPT 610 - 010

TITLE SKIN ~ SANDWICH, CONSTANT THICK CORE/NO SLUGS

CONCEPT DESCRIPTION SANDWICH CONCEPT WITH THICK LOAD CARRYING INNER SKIN STABILIZED FOR COMPRESS & SHEAR WITH HONEYCOMB CORE & THIN OUTER SKIN. NO SLUGS EXIST BETWEEN SKINS - CORE IS CONSTANT THICKNESS. ALL MILLING IS PERFORMED ON OUTSIDE SURF. OF LOWER SKIN

APPLICATION SKIN WITH HIGH COMPRESSION LOADS OR SHEAR WHERE STABILITY IS A PROBLEM

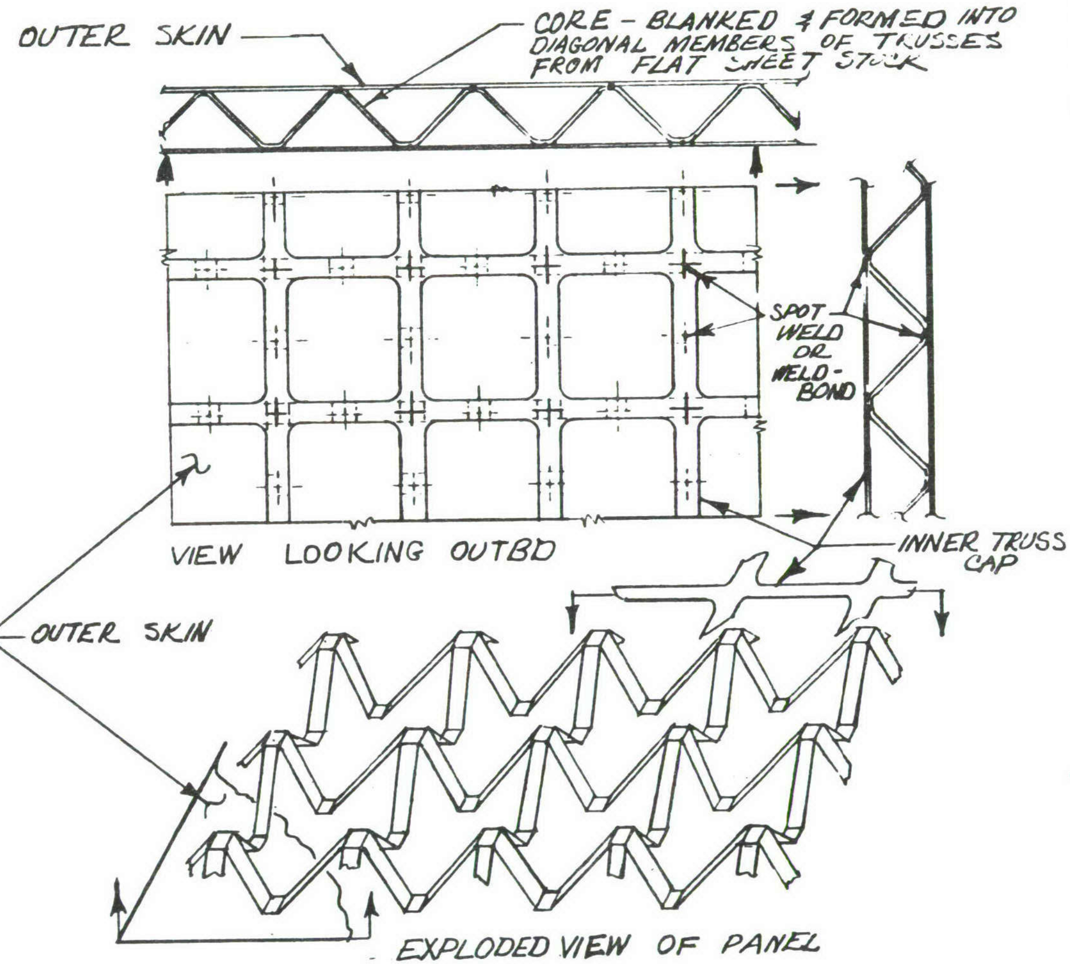
MATERIALS AL ALLOY - ADHESIVE BONDED
TI ALLOY BRAZED OR ADHESIVE BONDED

LOAD RANGE 1000 TO 25000 #/in AXIAL
100 - 15000 #/in SHEAR

CONCEPT FEATURES
- ELIMINATING SLUGS & CORE FIT PROBLEM WILL REDUCE PANEL MFG COSTS.
- GOOD STABILITY IN COMPRESSION AND SHEAR

PREPARED BY R.W. McEnally DATE 6/13/72

GENERAL DYNAMICS
Convair Aerospace Division
Fort Worth Operation



STRUCTURAL CONCEPT 610-011

TITLE SKIN ~ TRUSSED LATTICE STABILIZED

CONCEPT DESCRIPTION TRUSSED LATTICE STABILIZED SKIN CONSIST OF 3 MEMBERS - AN OUTER SKIN, BLANKED & FORMED CORE & A BLANKED LATTICE TO FORM INNER TRUSS CAP. THE THREE MEMBERS ARE JOINED BY SPOTWELD OR WELD BOND

APPLICATION COMPRESSION AND/OR PRESS. LOADED SKIN.

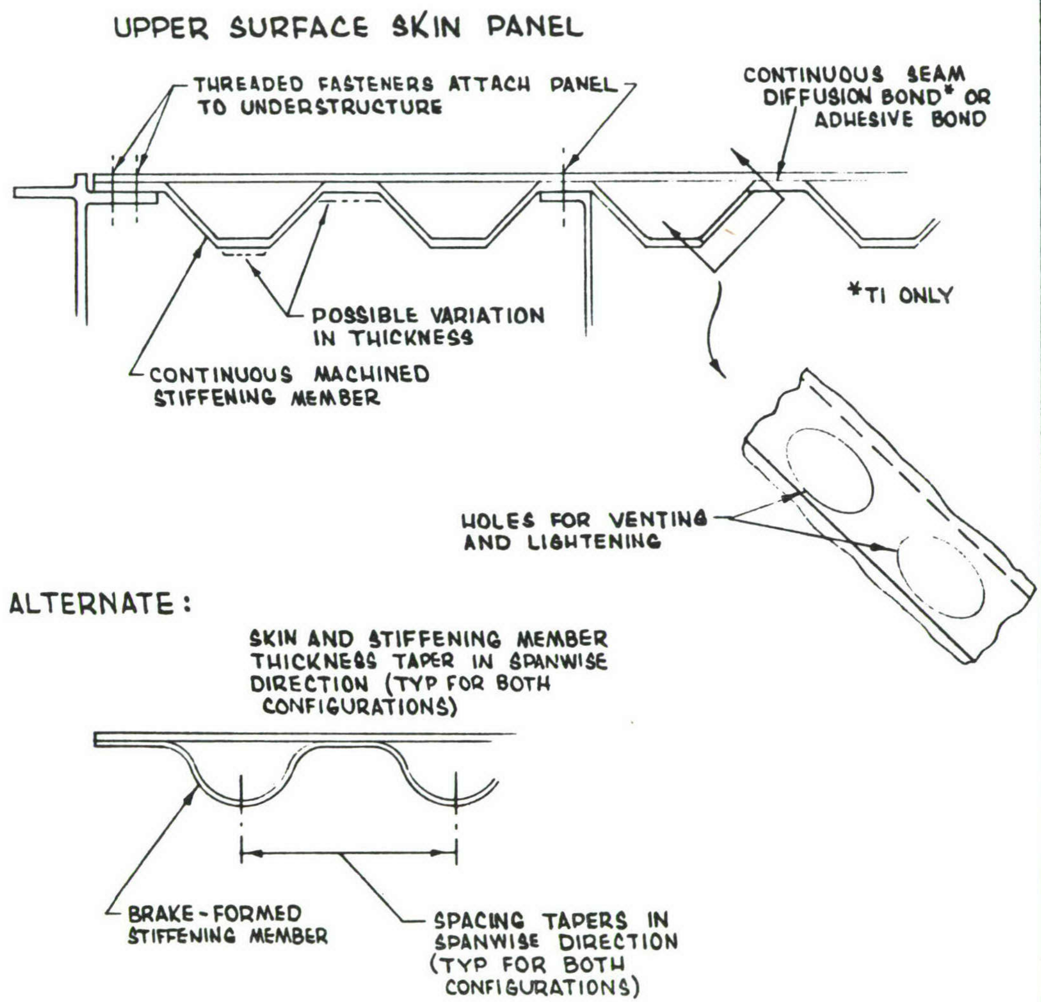
MATERIALS ALUMINUM, TITANIUM OR STEEL

LOAD RANGE 10 TO 5000#/in AXIAL LOAD

CONCEPT FEATURES
- LIGHT & INEXPENSIVE METHOD OF STABILIZING LIGHTLY LOADED SKIN PANEL

PREPARED BY [signature] DATE 6-13-72

GENERAL DYNAMICS
Convair Aerospace Division
Fort Worth Operation



STRUCTURAL CONCEPT 610-012

TITLE SKIN PANEL - UPPER WING, STIFFENED

CONCEPT DESCRIPTION PLATE - STIFFENER PANEL. CONTINUOUS TRUSS-LIKE STIFFENING MEMBER JOINED TO SKIN BY ADHESIVE BONDING OR BY CONTINUOUS SEAM DIFFUSION BONDING

APPLICATION WING COMPRESSION SKIN

MATERIALS ALUMINUM OR TITANIUM

LOAD RANGE

CONCEPT FEATURES

- INCORPORATES SPANWISE TAPER IN ALL DIMENSIONS
- MINIMIZES FASTENER HOLES

PREPARED BY D. E. [signature] DATE 6.14.72

GENERAL DYNAMICS
Convair Aerospace Division
Fort Worth Operation

STRUCTURAL CONCEPT 610-013

TITLE SKIN ~ SANDWICH, PYRAMID CORE

CONCEPT DESCRIPTION PYRAMID CORE SANDWICH SKIN IS A CONCEPT THAT UTILIZES A CORE FORMED INTO A SERIES OF PYRAMIDS AND JOINED TO AN INNER AND OUTER SKIN BY ADHESIVE BONDING, BRAZING, [illegible] OR WELD BONDING

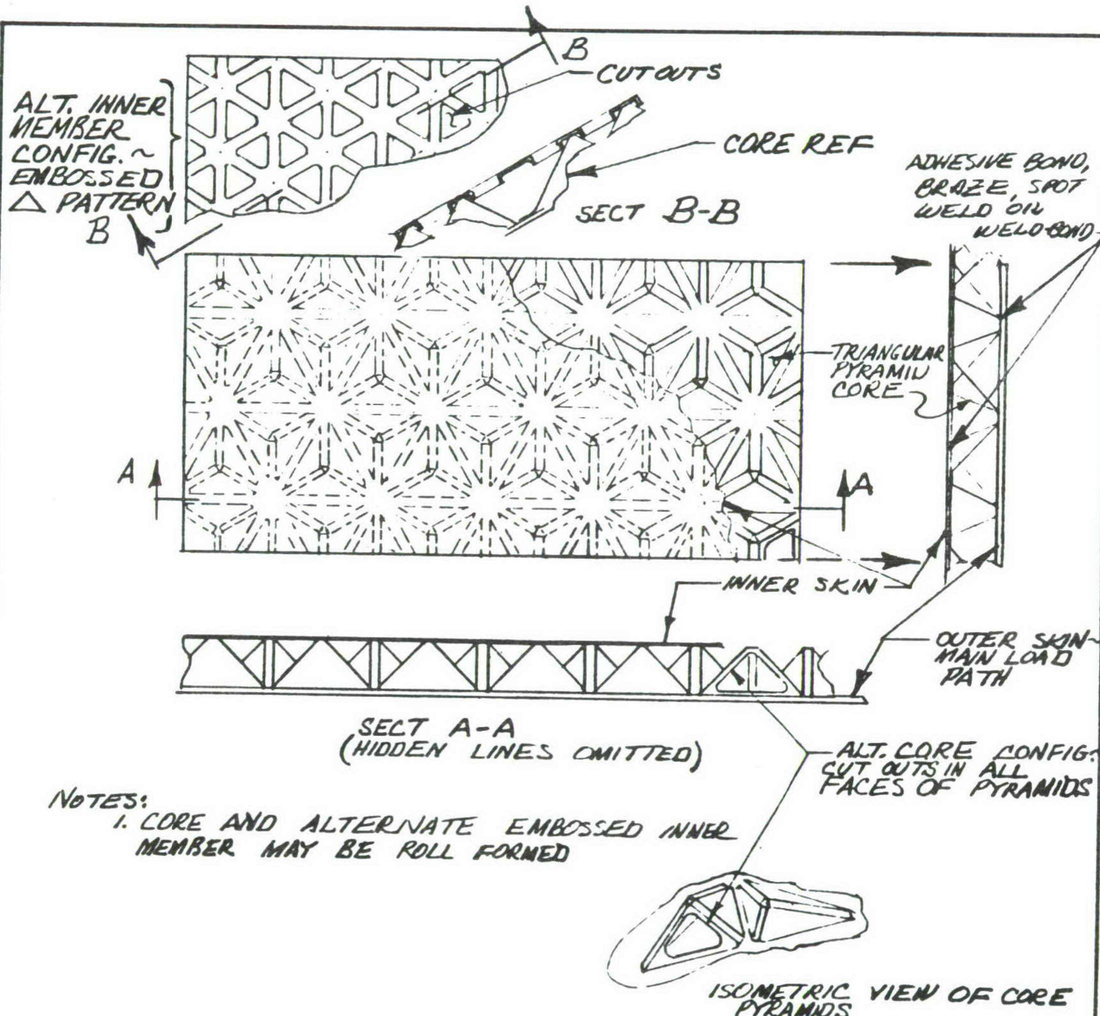
APPLICATION COMPRESSION AND SHEAR LOADED SKINS OR SHEAR WEBS.

MATERIALS Ti, AL OR STEEL

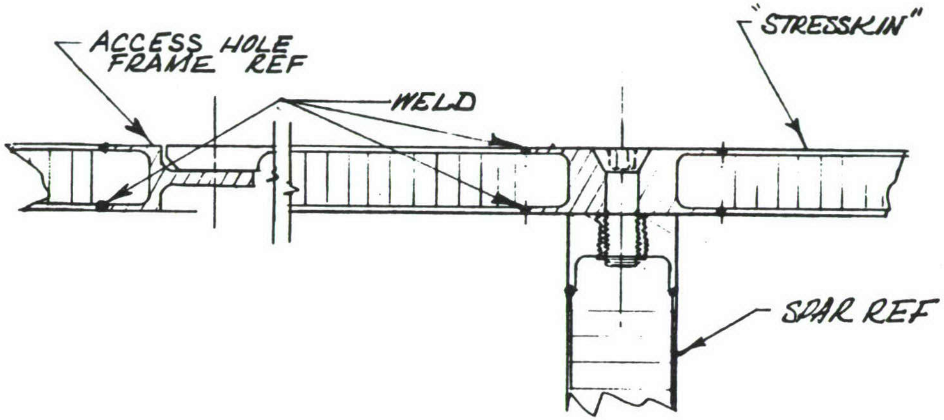
LOAD RANGE 100 — 25,000#/IN AXIAL OR 100 — 15,000#/IN SHEAR FLOW

CONCEPT FEATURES
- CORE HAS MORE CONTACT AREA WITH SKINS THAN HONEY-COMB CORE
- ROLL FORMING CORE OFFERS AN ECONOMICAL MEANS OF FABRICATING CORE

PREPARED BY [signature] DATE 6-14-72



NOTES:
1. CORE AND ALTERNATE EMBOSSED INNER MEMBER MAY BE ROLL FORMED



VIEW LOOKING INBOARD

STRUCTURAL CONCEPT

610-014

TITLE SKIN - SANDWICH, UPPER "STRESSKIN" WITH WELD-IN PROVISIONS FOR SPAR/FRAME ATTACHMENT

CONCEPT DESCRIPTION THIS CONCEPT INCORPORATES STRESSKIN SANDWICH WITH WELD-IN PROVISIONS FOR ATTACHING SPARS, DOOR FRAMES ETC.

APPLICATION UPPER SKIN WITH HIGH COMPRESSION LOAD

MATERIALS TITANIUM OR STEEL

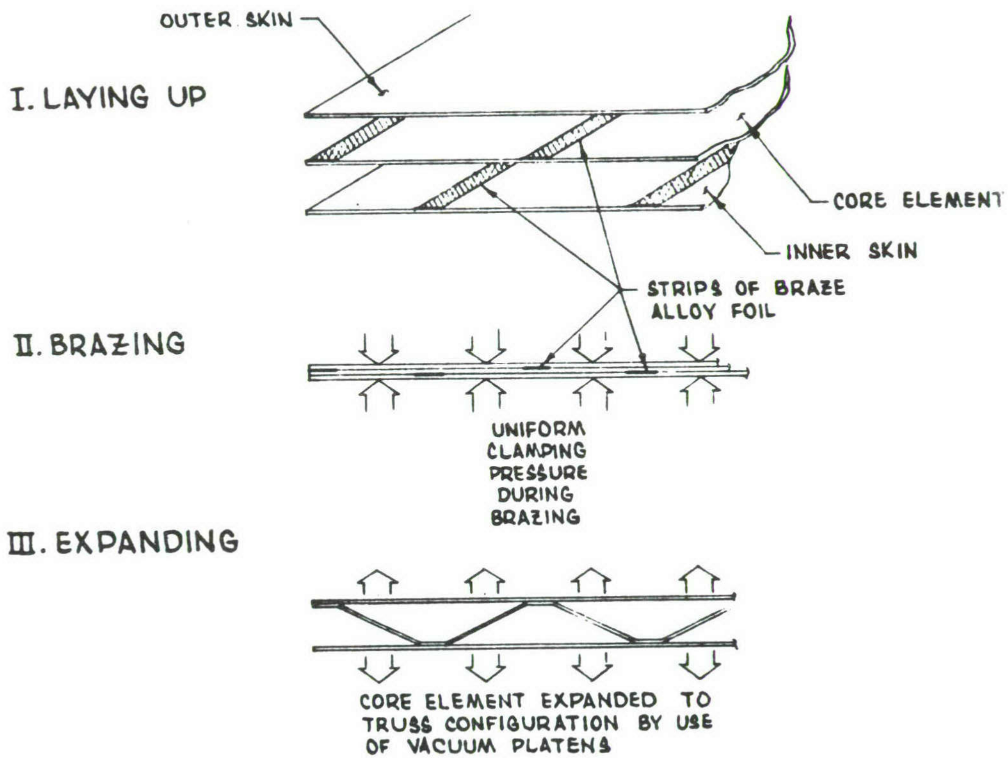
LOAD RANGE 1000 TO 25,000 #/in COMPRESSION

CONCEPT FEATURES
- GOOD COMPRESSION/SHEAR STABILITY
- HIGH TEMP RESISTANCE
-
-

SOURCE: BOMBER CTB ADP

PREPARED BY [illegible] DATE 6-15-72

GENERAL DYNAMICS
Convair Aerospace Division
Fort Worth Operation



STRUCTURAL CONCEPT 610-015

TITLE: SKIN PANEL - SANDWICH, EXPANDED TRUSS CORE

CONCEPT DESCRIPTION: A FLAT CORE ELEMENT IS POSITIONED BETWEEN TWO SKINS, BRAZED AT "NODE LINES", AND THEN EXPANDED TO THE TRUSS CONFIGURATION USING VACUUM.

APPLICATION: WING COMPRESSION SKIN

MATERIALS: TITANIUM, STEEL

LOAD RANGE:

CONCEPT FEATURES:

- GOOD PANEL RIGIDITY
- ELIMINATES NEED FOR FORMING OR MACHINING THE CORE ELEMENT
- ADAPTABLE FOR USE AS SHEAR WEB IN SPAR DESIGN

PREPARED BY: [signature] DATE: 6.19.72

GENERAL DYNAMICS
Convair Aerospace Division
Fort Worth Operation

STRUCTURAL CONCEPT 610-016

TITLE SKIN PANEL - SANDWICH, TRUSS CORE

CONCEPT DESCRIPTION
SANDWICH PANEL WITH INNER AND OUTER SKINS BONDED TO A TRUSS TYPE CORE MEMBER

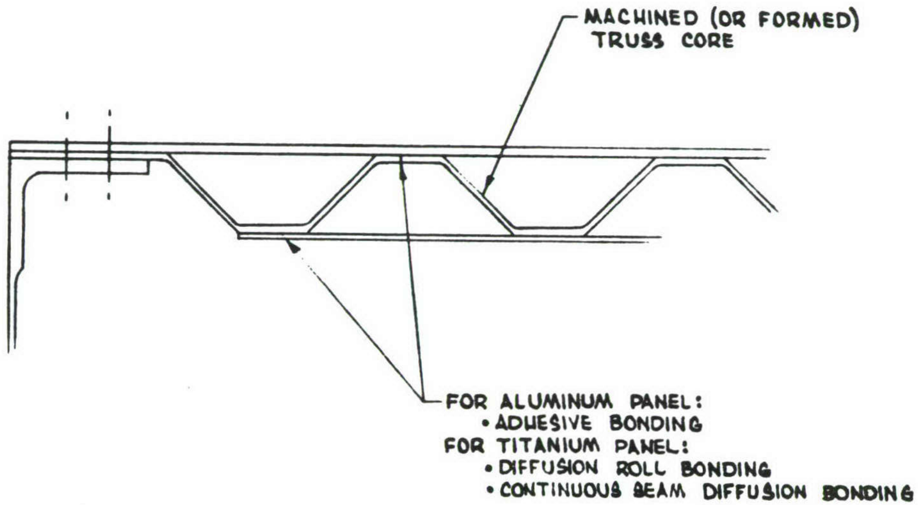
APPLICATION
WING COMPRESSION SKIN

MATERIALS ALUMINUM, TITANIUM

LOAD RANGE

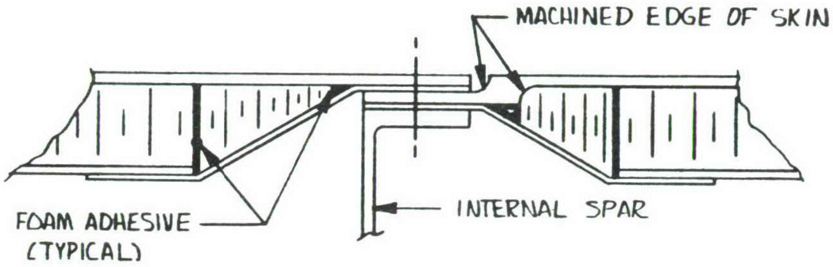
CONCEPT FEATURES

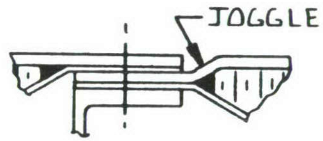
- GOOD PANEL RIGIDITY
- ADAPTABLE FOR USE AS SHEAR WEB IN SPAR DESIGN



PREPARED BY D. E. Bloom DATE 6.16.72

GENERAL DYNAMICS
Convair Aerospace Division
Fort Worth Operation





ALTERNATE METHOD OF MANUFACTURE

STRUCTURAL CONCEPT 610-017

TITLE SKIN PANEL, SANDWICH WITH OVERLAPPING EDGE MEMBERS

CONCEPT DESCRIPTION ADHESIVE BONDED SANDWICH PANELS HAVE 1 EDGE OFFSET TO PERMIT OVERLAP AT JOINT.

APPLICATION
COMPRESSION SKIN

MATERIALS
ALUMINUM

LOAD RANGE

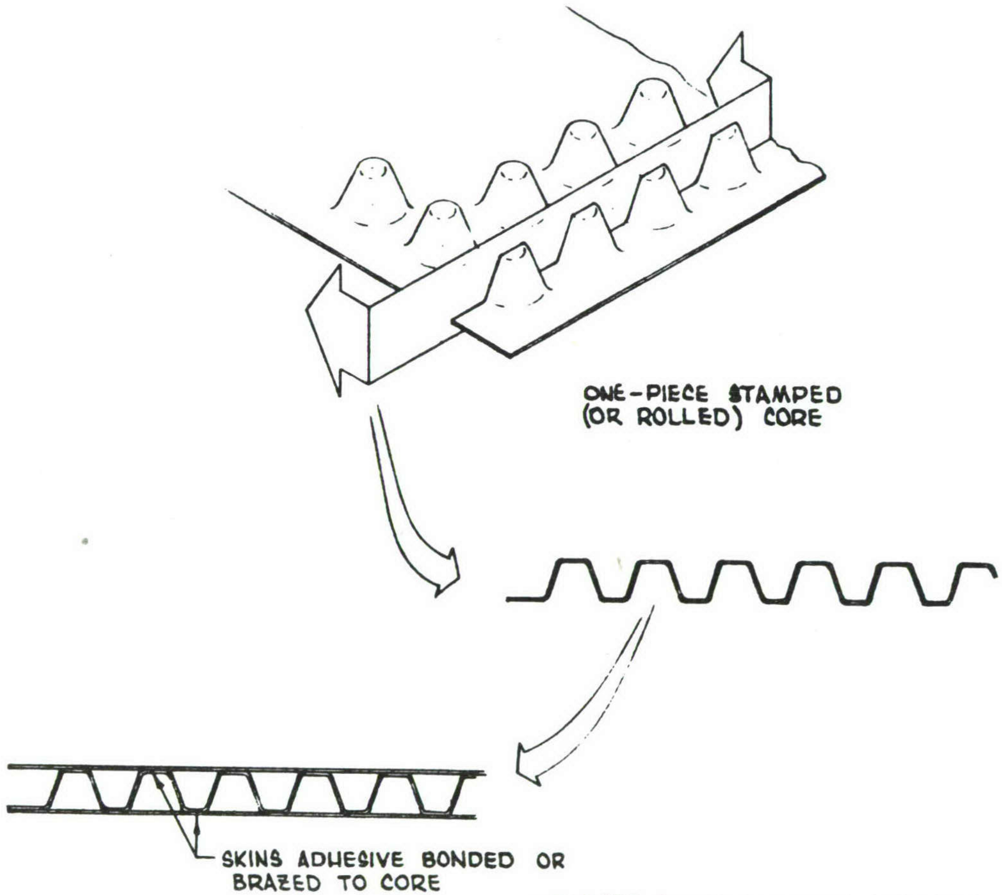
CONCEPT FEATURES

ADVANTAGES ~
1. GOOD TRANSFER OF CHORD WISE LOADS
2. FAIL SAFE DESIGN

DISADVANTAGES ~
1. OFFSET EDGE MEMBER UNSYMETRICAL ABOUT NEUTRAL AXIS

PREPARED BY J.D. Bixler DATE 6/19/72

GENERAL DYNAMICS
Convair Aerospace Division
Fort Worth Operation



• IF MADE FROM TITANIUM, ONE SKIN COULD BE DIFFUSION BONDED, THEN THE OTHER ONE ADHESIVE BONDED

STRUCTURAL CONCEPT 610-018

TITLE
SKIN PANEL - SANDWICH,
ONE-PIECE STAMPED CORE

CONCEPT DESCRIPTION
CORE MADE FROM FORMED SHEET THEN USED TO FABRICATE A CONVENTIONAL SANDWICH SKIN PANEL

APPLICATION
WING COMPRESSION SKIN

MATERIALS
ALUMINUM, TITANIUM

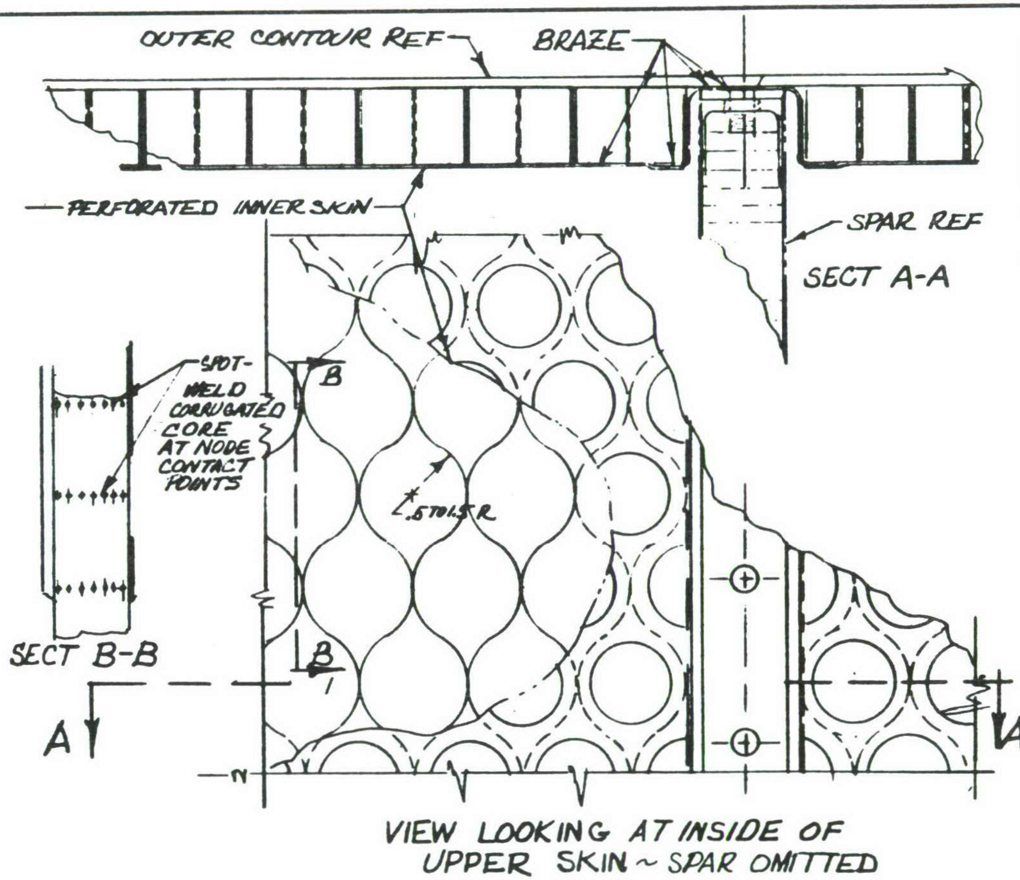
LOAD RANGE

CONCEPT FEATURES

- POSSIBLE COST SAVING FOR CORE MANUFACTURE
- STRENGTH INCREASE FOR TITANIUM PANEL BY BEING ABLE TO DIFFUSION BOND ONE SKIN TO THE CORE

PREPARED BY D. E. [signature] DATE 6.19.72

GENERAL DYNAMICS
Convair Aerospace Division
Fort Worth Operation



STRUCTURAL CONCEPT 610-019

TITLE SKIN ~ CORRUGATED WEB CORE/PERFORATED INNER SHEET STABILIZED

CONCEPT DESCRIPTION SKIN CONCEPT THAT UTILIZES CORRUGATED WEBS SPOT-WELD JOINED AT NODE CONTACTS WITH INNER PERFORATED SHEET. INNER SHEET & AND OUTER SKIN ARE BRAZED TO THE CORRUGATED WEBS.

APPLICATION UPPER SKIN WITH COMPRESSION & SHEAR LOADS

MATERIALS TITANIUM OR STEEL

LOAD RANGE 1800 — 25000#/IN AXIAL LOAD

CONCEPT FEATURES
- LIGHT WEIGHT COMPRESSION STABILIZATION
- MINIMUM FUEL VOLUME LOSS.

PREPARED BY [signature] DATE 6-23-72

GENERAL DYNAMICS
Convair Aerospace Division
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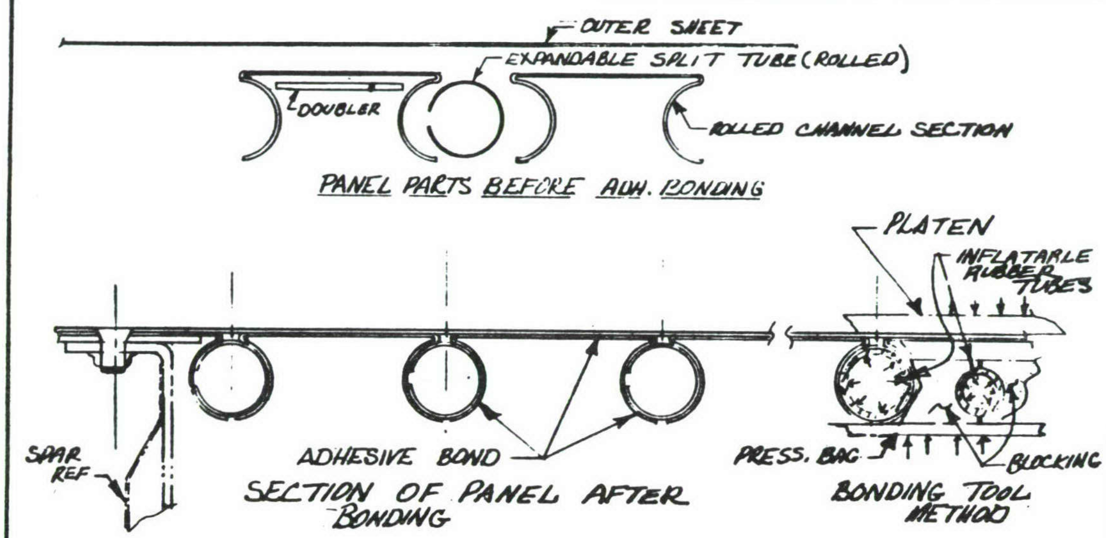


STRUCTURAL CONCEPT 610-020

TITLE SKIN - BULB STIFFENED/ ADHESIVE BONDED

CONCEPT DESCRIPTION BULB STIFFENED, ADHESIVE BONDED PANEL MADE UP OF FLAT OR TAPERED SHEET. FORMING OF STIFFENER MEMBERS IS ACCOMPLISHED BY ROLLING. BONDING PRESSURE FOR BUILT-UP TUBULAR STIFFENERS IS FROM INFLATABLE TUBES

APPLICATION COMPRESSION PANEL

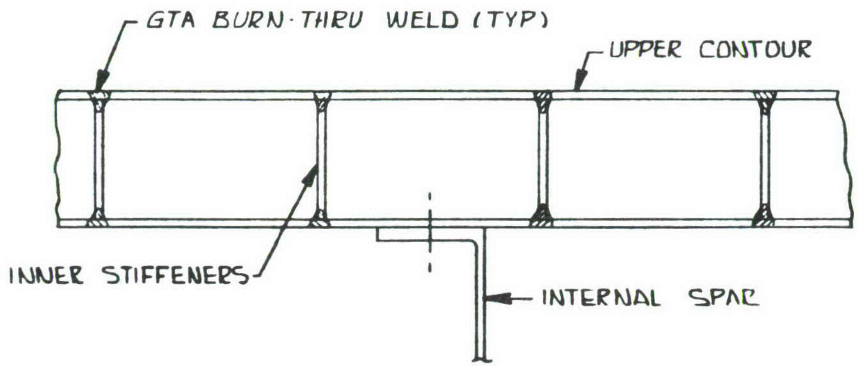
MATERIALS ALUMINUM OR TITANIUM

LOAD RANGE 1000 TO 25,000# IN AXIAL LOAD

CONCEPT FEATURES
- GOOD COMPRESSION STABILITY
- PANEL HAS TENSION CONTINUITY PERPENDICULAR TO STIFFENERS

PREPARED BY RWM Emally   DATE 6-28-72

GENERAL DYNAMICS
Convair Aerospace Division
Fort Worth Operation



STRUCTURAL CONCEPT | 610-0[illegible]1

TITLE SKIN PANEL, RECTANGULAR TUBE ELEMENTS, GTA

CONCEPT DESCRIPTION INNER STIFFENERS ARE WELDED TO SKINS USING GTA METHOD.

APPLICATION
COMPRESSION SKIN

MATERIALS ANNEALED 6AL-4V TITANIUM

LOAD RANGE

CONCEPT FEATURES

ADVANTAGES ~

1. MORE STABLE THAN HAT SECTIONS.
2. NO NON-WORKING STABILIZATION MATL (e.g. - ADHESIVE)

DISADVANTAGES ~

1. CHILL BARS MAY LIMIT LENGTH OF PANEL
2. FASTENING TO INTERNAL SPARS DIFFICULT

PREPARED BY (R.N. BAYLOR) | **DATE** 7/10/72

GENERAL DYNAMICS
Convair Aerospace Division
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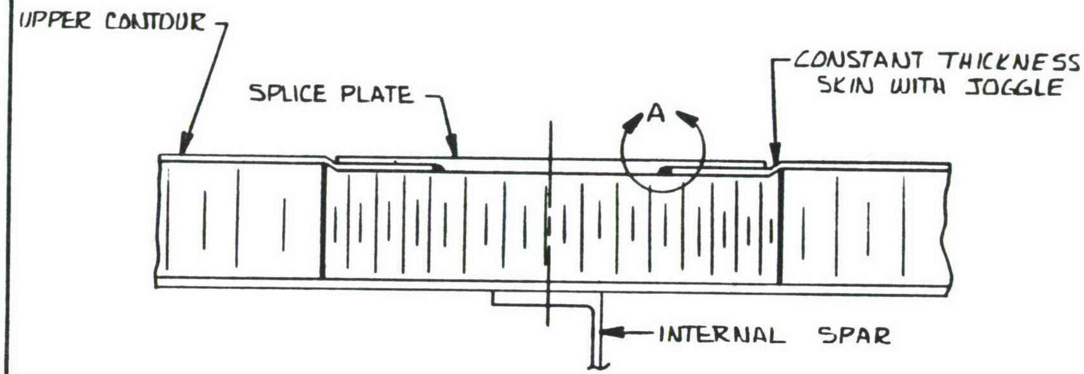

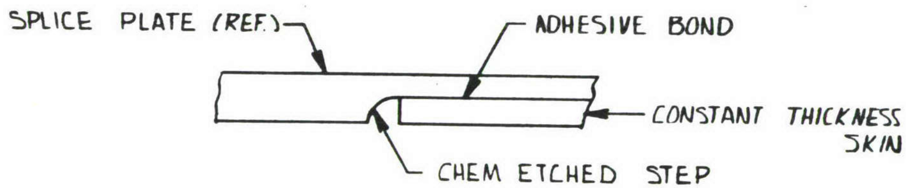

DETAIL A

STRUCTURAL CONCEPT 610-022

TITLE SKIN, CONSTANT DEPTH SANDWICH WITH SPLICE PLATE

CONCEPT DESCRIPTION ~ A SPLICE PLATE IS BONDED INTO A SANDWICH PANEL DURING THE FABRICATION SEQUENCE. OUTER SKIN IS JOGGLED TO ACCEPT SPLICE PLATE.

APPLICATION
COMPRESSION SKIN

MATERIALS ALUMINUM

LOAD RANGE

CONCEPT FEATURES

ADVANTAGES ~

1. MINIMIZES AMOUNT OF MATERIAL TO BE CHEM ETCHED AWAY.

DISADVANTAGES ~

1. JOGGLE INTRODUCES ECCENTRICITY TO CHORDWISE AND TORSIONAL LOADS.

PREPARED BY J. D. Baylor (R.N. BAYLOR) DATE 7/10/72

GENERAL DYNAMICS
Convair Aerospace Division
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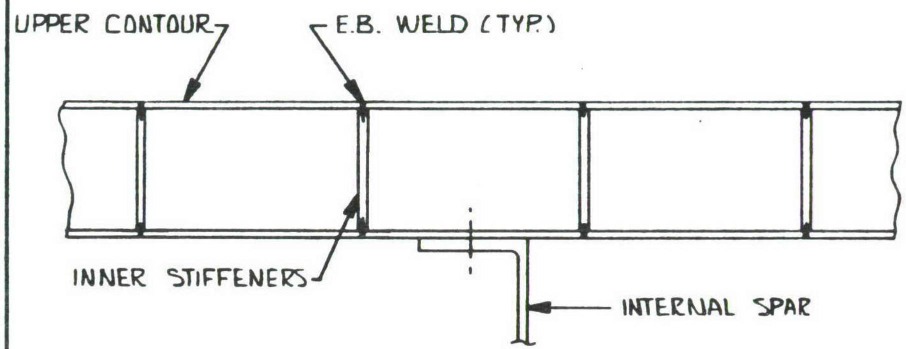


NOTE ~
JOINT PENALTY FOR E.B. WELDING TO BE DETERMINED.

STRUCTURAL CONCEPT 610-023

TITLE SKIN PANEL, RECTANGULAR TUBE ELEMENTS, E.B.

CONCEPT DESCRIPTION INNER STIFFENERS ARE WELDED TO SKINS USING E.B. METHOD.

APPLICATION
COMPRESSION SKIN

MATERIALS BETA III OR 8-8-2-3 TITANIUM IN STA OR STOA CONDITION

LOAD RANGE

CONCEPT FEATURES

ADVANTAGES ~

1. E.B. WELDING PERMITS USE OF HIGH HEAT TREAT MATERIAL FOR BETTER EFFICIENCY.

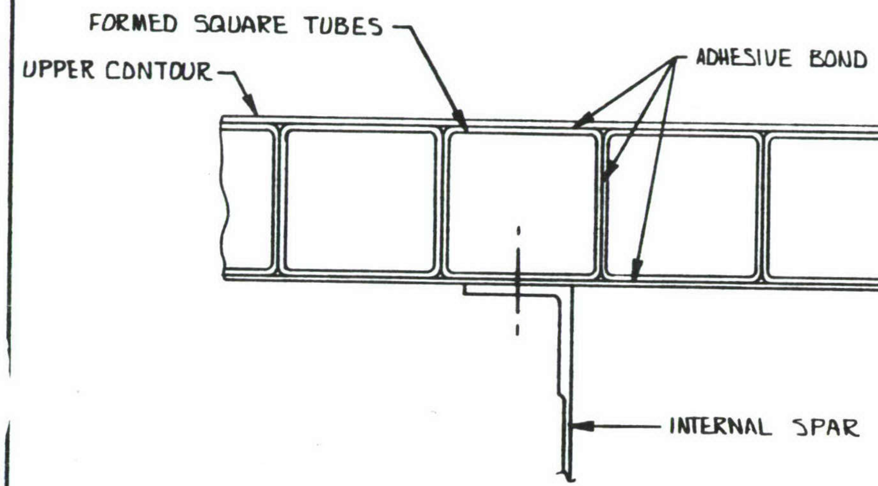
DISADVANTAGES ~

1. SAME AS DWG. NO. 610-021

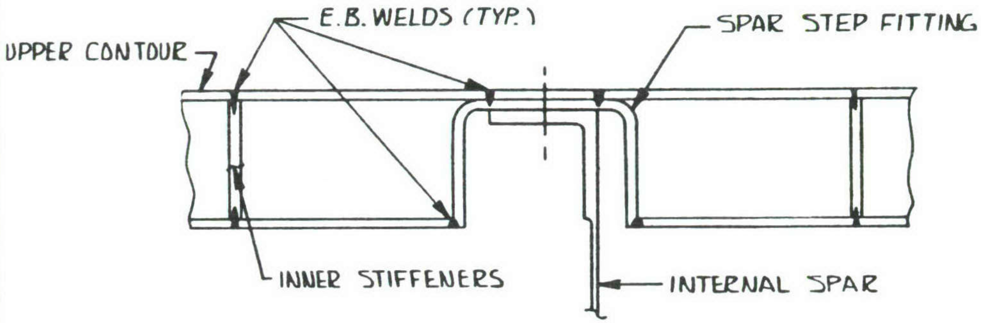
PREPARED BY (K N BAYLOR) J.D. Baylor

DATE 7/11/72

GENERAL DYNAMICS
Convair Aerospace Division
Fort Worth Operation



STRUCTURAL CONCEPT	610-024
TITLE SKIN, SQUARE TUBE SANDWICH	
CONCEPT DESCRIPTION~ SQUARE TUBES ARE FORMED AND ADHESIVE BONDED BETWEEN AN INNER AND AN OUTER SKIN.	
APPLICATION COMPRESSION SKIN	
MATERIALS BETA III OR 8-8-2-3 TITANIUM	
LOAD RANGE	
CONCEPT FEATURES ADVANTAGES~ 1. FAIL SAFE DESIGN. 2. GOOD STABILITY. 3. MATERIAL USED EFFICIENTLY. DISADVANTAGES~ 1. SKIN PANEL-TO-SPAR ATTACHMENT DIFFICULT. 2. IMPACT ON FUEL VOLUME.	
PREPARED BY J.D. Bigler	DATE 7/12/72
GENERAL DYNAMICS Convair Aerospace Division Fort Worth Operation	



STRUCTURAL CONCEPT 610-025

TITLE SKIN, RECTANGULAR TUBE ELEMENTS, E.B., WITH SPAR STEP

CONCEPT DESCRIPTION ~ INNER STIFFENERS ARE E.B. WELDED TO SKINS. A SPAR STEP FTG IS WELDED IN TO MINIMIZE BOLT LENGTH.

APPLICATION
COMPRESSION SKIN

MATERIALS
BETA III OR 8-8-2-3 TITANIUM (STA OR STOA)

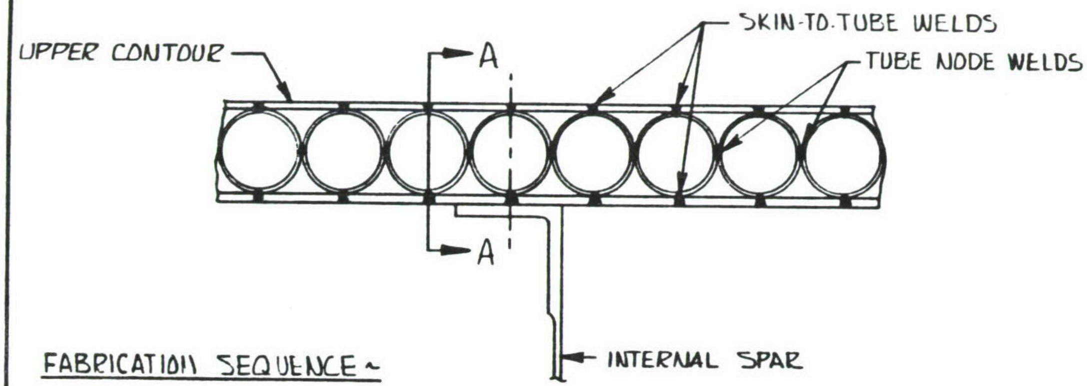
LOAD RANGE

CONCEPT FEATURES
ADVANTAGES ~
1. SAME AS DWG. NO. 610-021 AND 610-023
2. MINIMIZES BOLT BENDING

DISADVANTAGES ~
1. SAME AS DWG. NO. 610-021

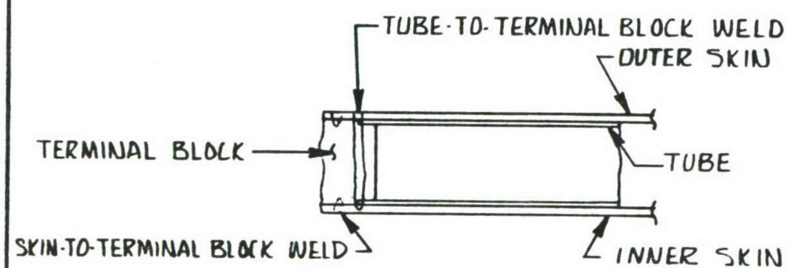
PREPARED BY J.D. Bixler | DATE 7/12/72

GENERAL DYNAMICS
Convair Aerospace Division
Fort Worth Operation



FABRICATION SEQUENCE ~

1. SIZE TAPERED TUBES
2. MAKE TUBE NODE WELDS USING E.B. WELDING
3. INSERT TUBES IN TERMINAL BLOCK AND EB. WELD
4. MAKE SKIN-TO-TUBE WELDS USING E.B. WELDING



SECTION A-A

STRUCTURAL CONCEPT 610-026

TITLE SKIN, TUBE STIFFENED SANDWICH

CONCEPT DESCRIPTION TAPERED CIRCULAR TUBES ARE E.B. WELDED BETWEEN INNER AND OUTER SKINS TO FORM SKIN PANEL

APPLICATION
COMPRESSION SKINS

MATERIALS
ALUMINUM OR TITANIUM

LOAD RANGE

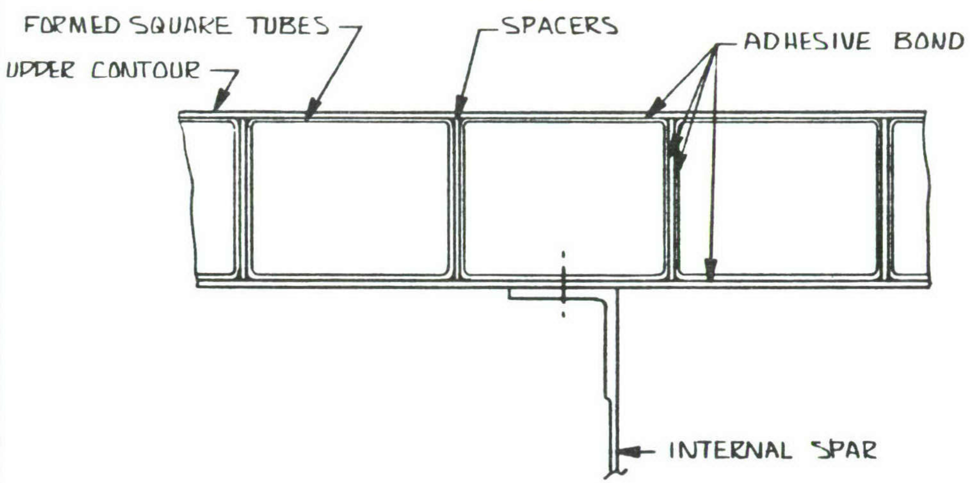
CONCEPT FEATURES
ADVANTAGES ~
1. STIFFENING MATERIAL ALSO CARRIES AXIAL LOAD
2. TUBES CAN BE USED FOR COOLING

DISADVANTAGES ~
1. TERMINAL BLOCK HEAVY

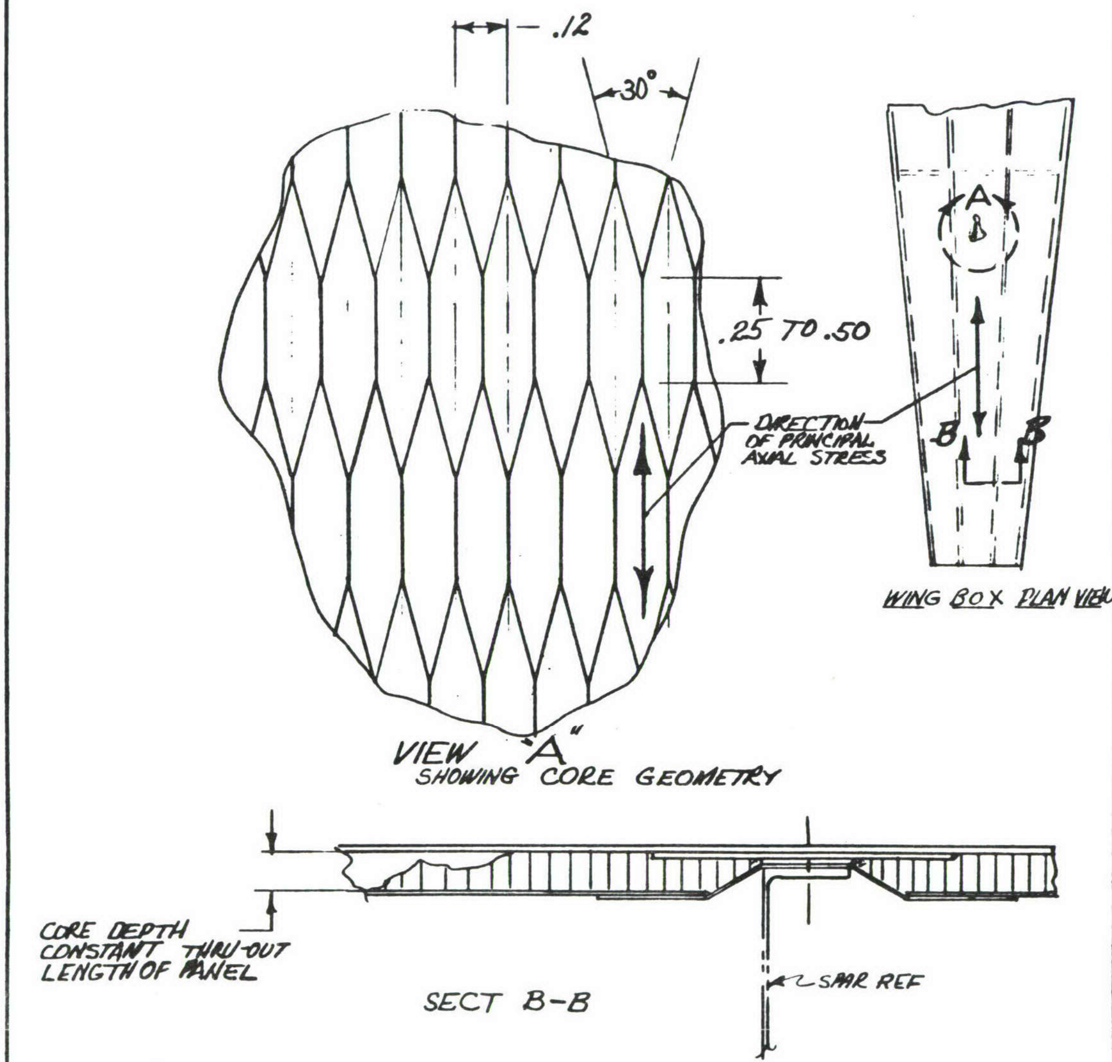
PREPARED BY (N. CARTER) J D Bixler

DATE 7/12/72

GENERAL DYNAMICS
Convair Aerospace Division
Fort Worth Operation



STRUCTURAL CONCEPT	610-027
TITLE SKIN, SQUARE TUBE SANDWICH WITH REINFORCING SPACER	
CONCEPT DESCRIPTION ~ SQUARE TUBES ARE FORMED AND ADHESIVE BONDED BETWEEN AN INNER AND AN OUTER SKIN. SPACERS ARE USED BETWEEN TUBES FOR EXTRA STABILITY.	
APPLICATION COMPRESSION SKIN	
MATERIALS BETA III OR 8-8-2-3 TITANIUM	
LOAD RANGE	
CONCEPT FEATURES ADVANTAGES ~ 1. SAME AS DWG. NO 610-024 DISADVANTAGES ~ 1. SAME AS DWG. NO. 610-024	
PREPARED BY J. D. Bixler	DATE 7/12/72
GENERAL DYNAMICS Convair Aerospace Division Fort Worth Operation	



STRUCTURAL CONCEPT 610-028

TITLE SKIN ~ BONDED SANDWICH WITH CORE EFFECTIVE AS WING—BENDING MATL.

CONCEPT DESCRIPTION SANDWICH SKIN CONSIST WITH CORE GEOMETRY ARRANGED TO PICK UP AXIAL LOAD AND BE EFFECTIVE AS WING BENDING MATL. WHILE STABILIZING SKIN FACE SHEETS

APPLICATION COMPRESSION LOADED SKINS

MATERIALS AL OR TITANIUM

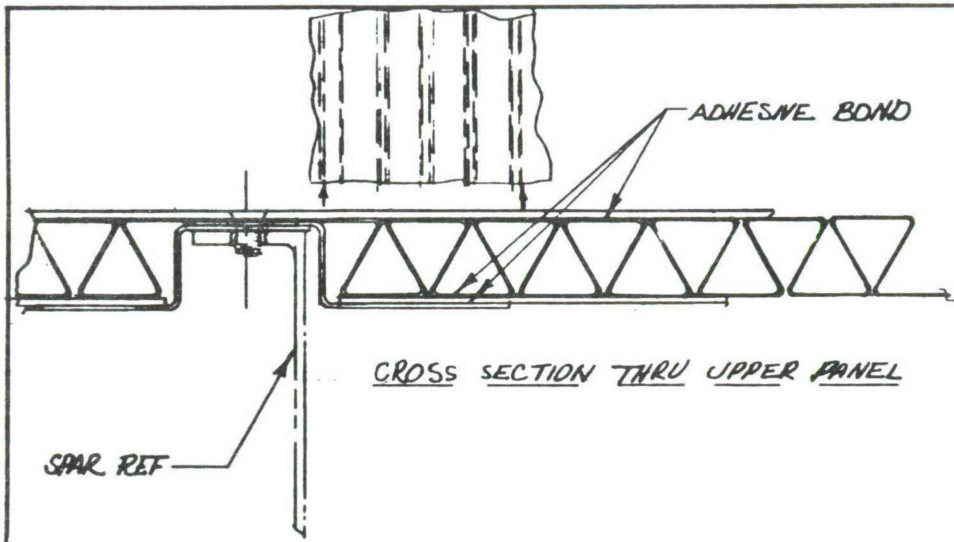
LOAD RANGE 1000 - 25,000 #/IN AXIAL LOAD

CONCEPT FEATURES
- IMPROVED STRUCTURAL EFFICIENCY FOR COMPRESSION PANELS

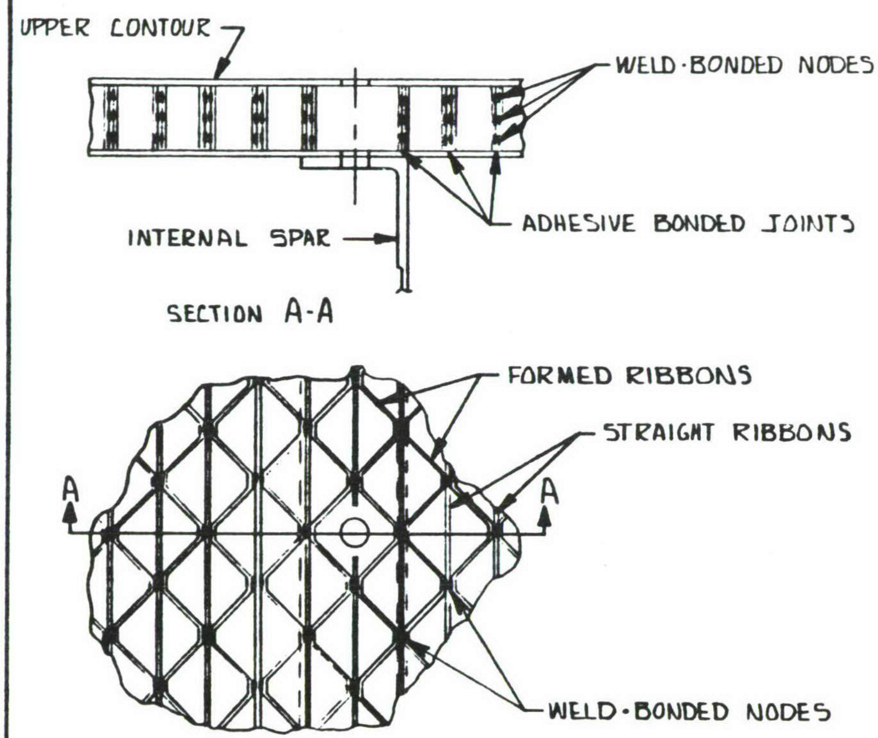
ORIGIN: INNOVATION - E.W. GOMEZ

PREPARED BY [signature] DATE 7-12-72

GENERAL DYNAMICS
Convair Aerospace Division
Fort Worth Operation



STRUCTURAL CONCEPT	610-029
TITLE SKIN ~ BONDED SANDWICH WITH TRIANGULAR CORRUGATED CORE	
CONCEPT DESCRIPTION BONDED SANDWICH WITH CORRUGATED CORE CONFIGURED INTO A TRIANGULAR PATTERN SUCH THAT PANEL WILL WORK AS A BEAM IN THE TRANVERSE PLANE AS WELL AS IN A LONGITUDINAL PLANE	
APPLICATION SKIN PANEL WITH INTERNAL PRESS, TRANSVERSE & LONGITUDINAL LOADS.	
MATERIALS ALUMINUM OR TITANIUM	
LOAD RANGE 1000 - 20000# AXIAL LOAD 1000 - 5000# TRANSVERSE COMPRESSION LOAD	
CONCEPT FEATURES • PANEL CORE WILL CARRY SHEAR & BENDING IN TRANSVERSE AS WELL AS LONGITUDINAL PLANE. • CORE MATL. IS 100% EFFECTIVE FOR CARRYING AXIAL LOAD IN LONGITUDINAL DIRECTION.	
PREPARED BY R W McAnally	DATE 7-13-72
GENERAL DYNAMICS Convair Aerospace Division Fort Worth Operation	



STRUCTURAL CONCEPT 610-030

TITLE SKIN PANEL, WELD BONDED SQUARE CELL REINFORCED CORE

CONCEPT DESCRIPTION ~ STRAIGHT RIBBONS AND FORMED RIBBONS ARE WELD-BONDED TOGETHER FIRST TO FORM CORE. CORE THEN ADHESIVE BONDED TO OUTER SKINS.

APPLICATION
COMPRESSION SKIN

MATERIALS
ALUMINUM OR TITANIUM

LOAD RANGE

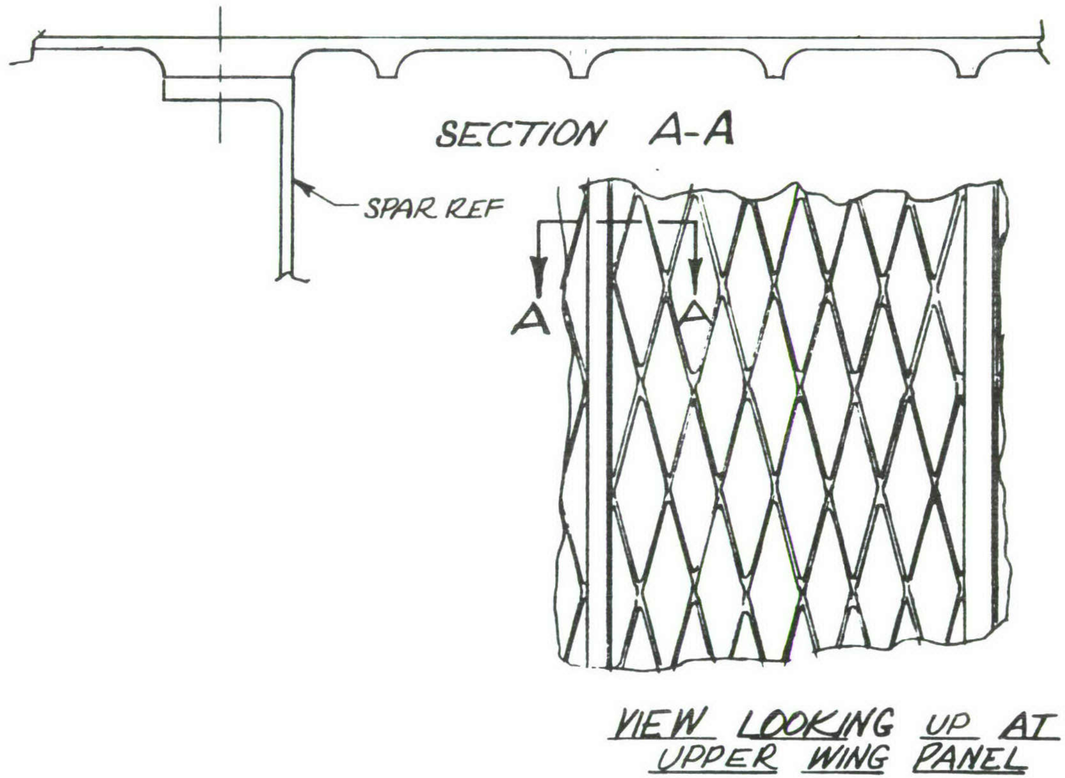
CONCEPT FEATURES

ADVANTAGES ~
1. GOOD AXIAL LOAD CARRYING ABILITY
2. MANUFACTURE EASILY AUTOMATED

DISADVANTAGES ~
1. BOLT BENDING

PREPARED BY J. D. Bigler   DATE 7/18/72

GENERAL DYNAMICS
Convair Aerospace Division
Fort Worth Operation



STRUCTURAL CONCEPT 610-031

TITLE SKIN~ UPPER WITH WAFFLE PATTERN INTEGRAL STIFFENERS

CONCEPT DESCRIPTION
UPPER SKIN PANEL CONCEPT HAVING WAFFLE PATTERN STIFFENERS INTEGRAL WITH SKIN. PANEL IS FABRICATED BY CHEMICAL MILLING

APPLICATION
COMPRESSION & SHEAR LOADED PANEL

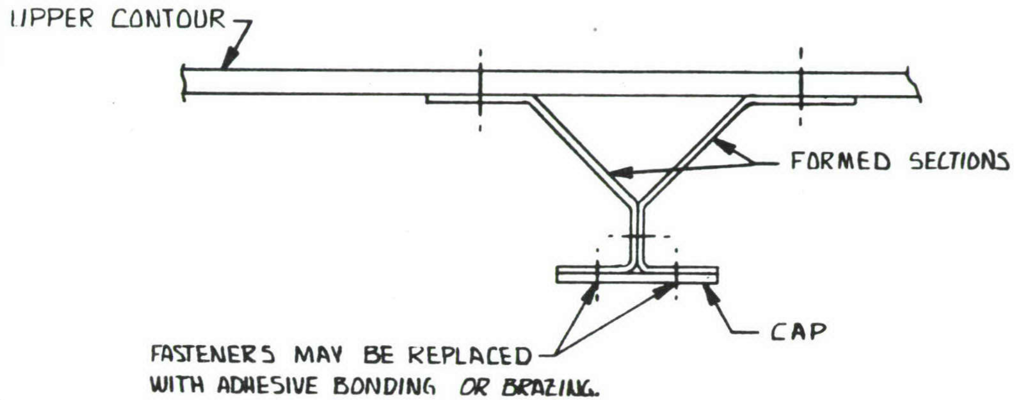
MATERIALS
ALUMINUM, TITANIUM OR STEEL

LOAD RANGE
1000 TO 25,000 #/IN AXIAL LOAD

CONCEPT FEATURES
- STRUCTURALLY EFFICIENT
- ECONOMICAL IN ALUMINUM ALLOY
- MINIMUM LOSS OF FUEL VOLUME

PREPARED BY RWMcAnally DATE 7-19-77

GENERAL DYNAMICS
Convair Aerospace Division
Fort Worth Operation



STRUCTURAL CONCEPT 610-032

TITLE SKIN PANEL, "Y" STIFFENED

CONCEPT DESCRIPTION ~ "Y" SECTIONS ARE MADE FROM FORMED SHEET AND BONDED, BRAZED, OR MECHANICALLY FASTENED TO UPPER SKIN.

APPLICATION
COMPRESSION SKIN

MATERIALS
BETA III OR 8-8-2-3 TITANIUM

LOAD RANGE

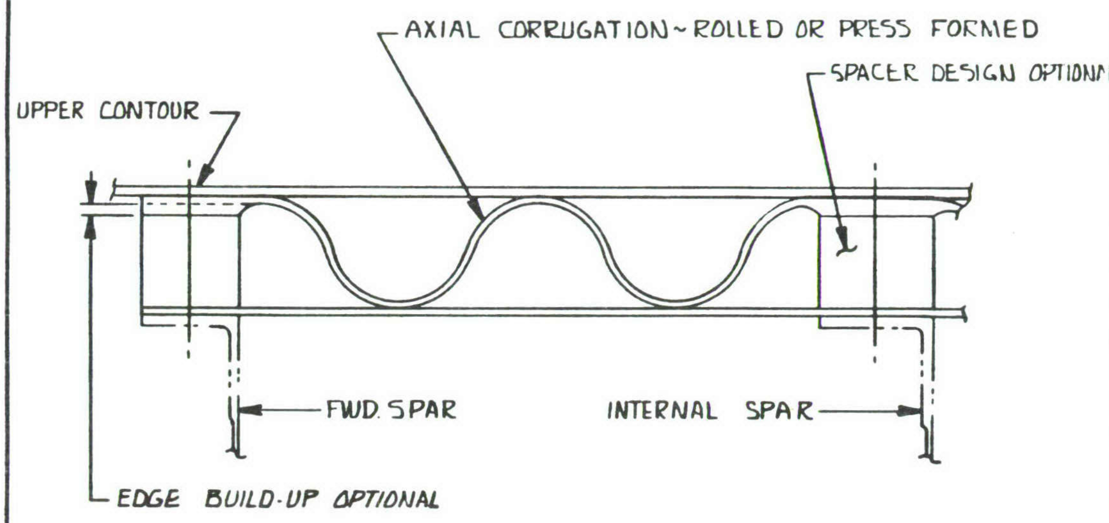
CONCEPT FEATURES

ADVANTAGES ~
1. EXCELLENT STIFFNESS
2. EASILY FORMED
3. VARYING THICKNESS OF "CAP" CAN TAILOR STIFFNESS

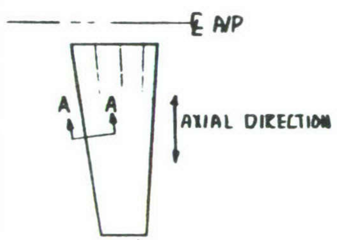
DISADVANTAGES ~
1. CRIPPLING OF LEGS HOLDING "CAP" CRITICAL.

PREPARED BY (R BAYLOR) | DATE 7/21/72

GENERAL DYNAMICS
Convair Aerospace Division
Fort Worth Operation



SECTION A-A



STRUCTURAL CONCEPT 610-033

TITLE SKIN PANEL, AXIAL CORRUGATION

CONCEPT DESCRIPTION ~ FLAT SHEET IS FORMED INTO CORRUGATED CONFIGURATION. EDGE BUILD-UPS ARE APPLIED AS REQ'D. INNER AND OUTER SKINS ATTACHED BY ADHESIVE BONDING OR BRAZING.

APPLICATION
COMPRESSION SKIN

MATERIALS
ALUMINUM OR TITANIUM

LOAD RANGE

CONCEPT FEATURES

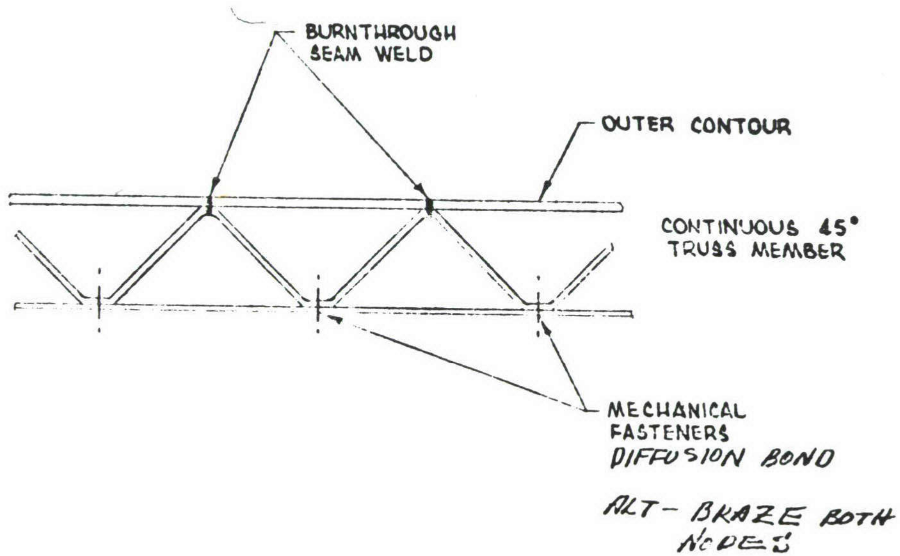
ADVANTAGES ~
1. CORRUGATIONS GOOD IN AXIAL DIRECTION
2. FAIL SAFE DESIGN

DISADVANTAGES ~
1. LOW CHORD WISE STIFFNESS
2. DEPENDING ON SPACE DESIGN, BOLT BENDING MAY BE A PROBLEM.
3. SPAR-TO-CORRUGATION DIFFICULT TO MATCH.

PREPARED BY J. D. Bixler | DATE 7/21/72

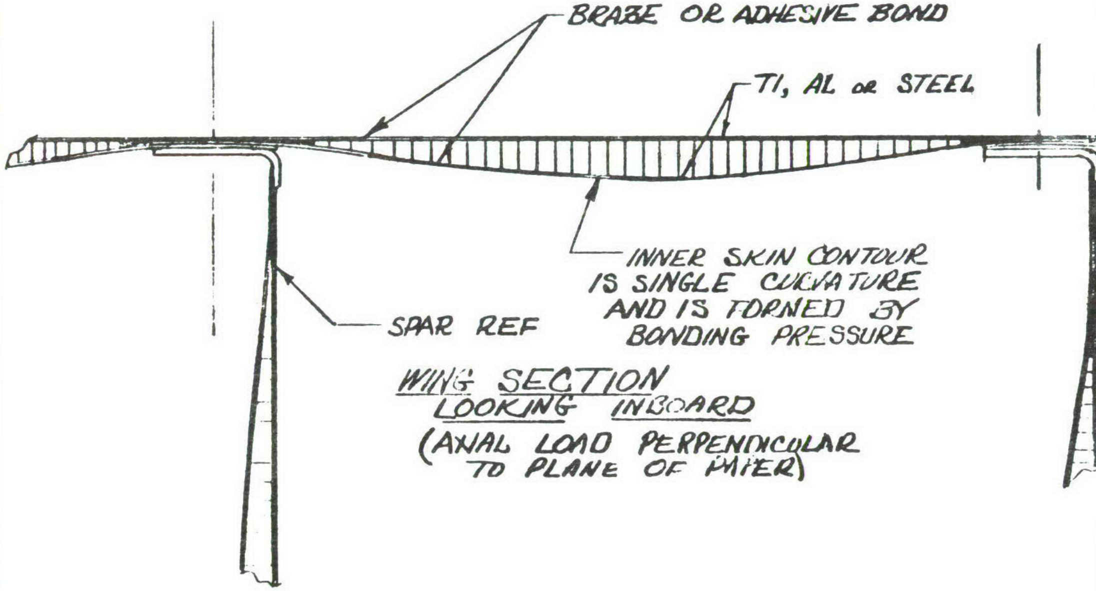
GENERAL DYNAMICS
Convair Aerospace Division
Fort Worth Operation

STRUCTURAL CONCEPT 610-034



TITLE	WING SKIN PANEL - SANDWICH, TRUSS MEMBER
CONCEPT DESCRIPTION	SANDWICH PANEL CONSTRUCTED WITH CONTINUOUS TRUSS MEMBER CORE WELDED TO OUTER SKIN
APPLICATION	WING COMPRESSION SKIN
MATERIALS	ALUMINUM, TITANIUM, STEEL
LOAD RANGE	
CONCEPT FEATURES	• HIGH EFFICIENCY IN BENDING ALONG BOTH CHORDWISE AND SPANWISE AXES • NO FASTENERS THROUGH OUTER SKIN; GOOD FATIGUE LIFE
PREPARED BY	J. E. Rom
DATE	7-25-72

GENERAL DYNAMICS
Convair Aerospace Division
Fort Worth Operation



STRUCTURAL CONCEPT 610-025

TITLE SKIN PANEL ~ SANDWICH WITH PRESSURE WRAPPED INNER SKIN

CONCEPT DESCRIPTION A SANDWICH PANEL CONCEPT WITHOUT EDGE MEMBERS. INNER SKIN IS FORMED DURING BONDING OR BRAZING

APPLICATION COMPRESSION OR SHEAR LOADED SKIN PANEL

MATERIALS TITANIUM, ALUMINUM OR STEEL

LOAD RANGE 500 TO 10,000 #/IN

CONCEPT FEATURES

- ELIMINATION OF EDGE MEMBERS ALONG LONGITUDINAL SIDES OF LONG PANELS WILL REDUCE COST AND WEIGHT OF PANEL FOR CERTAIN APPLICATIONS
- PANEL IS STABLE FOR COMPRESSION & SHEAR BUCKLING & INCORPORATES FAIL-SAFE CHARACTERISTICS

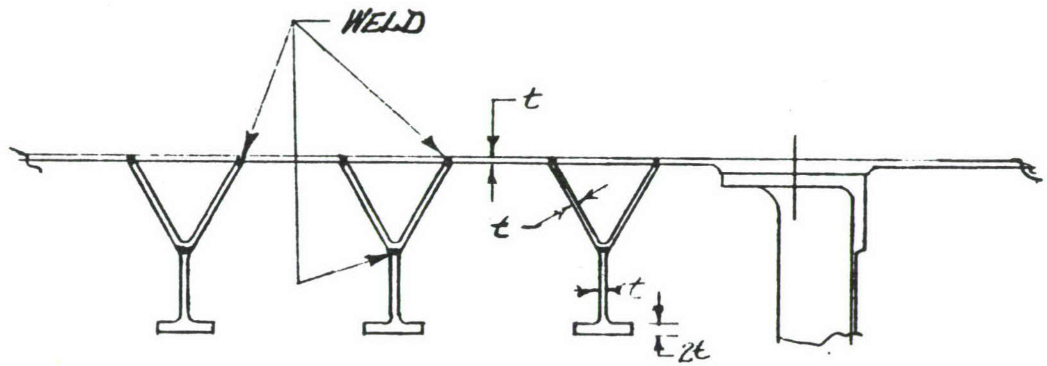
- ORIGIN ~ ORIGINATED DURING FIGHTER WING ADP PROGRAM

PREPARED BY [signature] DATE [illegible]

GENERAL DYNAMICS
Convair Aerospace Division
Fort Worth Operation

STRUCTURAL CONCEPT	610-036
TITLE COMPRESSION SKIN ~ [illegible] Y-TEE STIFFENED	
CONCEPT DESCRIPTION COMPRESSION SKIN CONCEPT [illegible] BY WELDED Y-TEE STIFFENERS [illegible] WELDING, OPTIMUM THICKNESS [illegible] CAN BE [illegible]	
APPLICATION COMPRESSION SKIN	
MATERIALS TI & STEEL	
LOAD RANGE 1000 TO 50,000#/IN AXIAL LOAD	
CONCEPT FEATURES 1. HIGHLY EFFICIENT SECTION FOR COMPRESSION LOAD	
PREPARED BY [illegible]	DATE 9-19-72

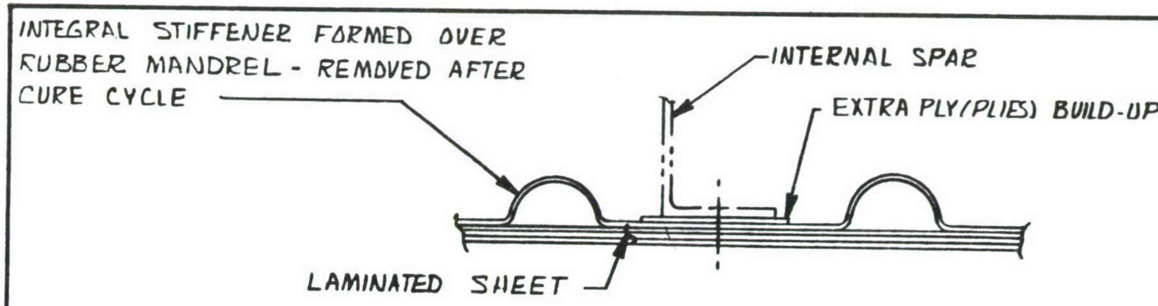
GENERAL DYNAMICS
Convair Aerospace Division
Fort Worth Operation

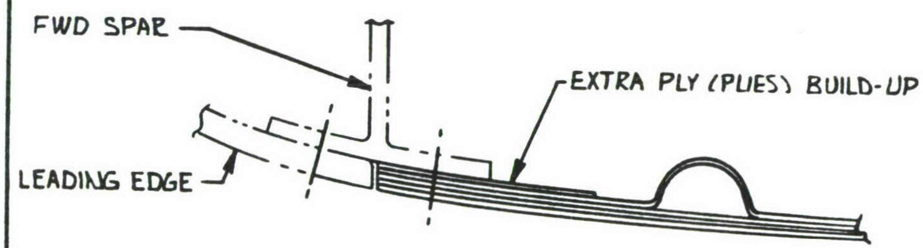


SECTION THRU UPPER WING SKIN
LOOKING INBOARD

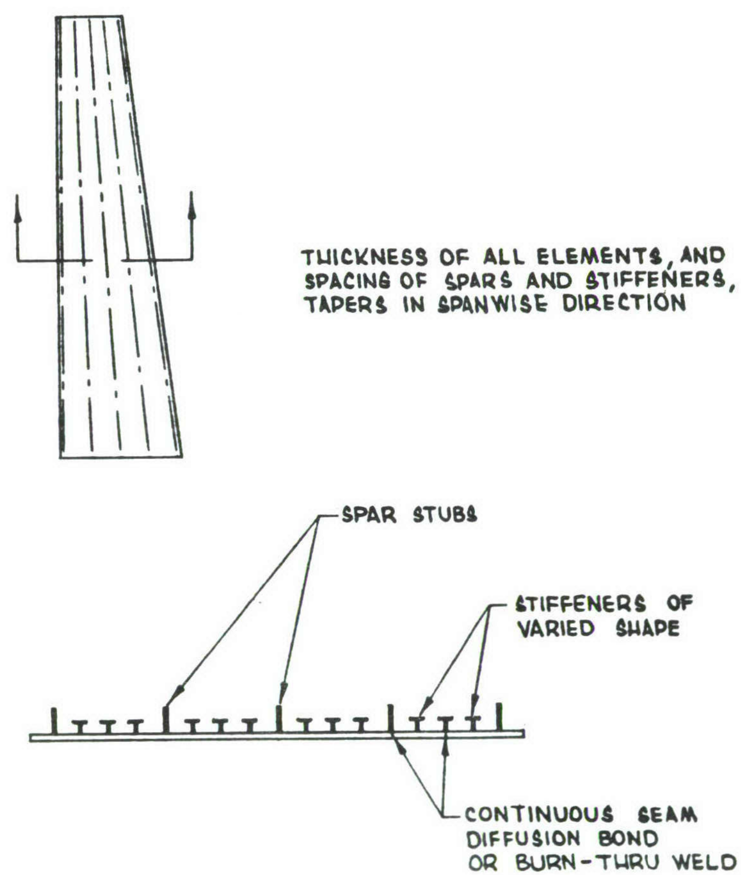
TENSION SKIN CONCEPTS

SKETCHES 610-100 THROUGH 610-133





STRUCTURAL CONCEPT	610 - 100
TITLE SKIN, LAMINATED, INTEGRALLY STIFFENED	
CONCEPT DESCRIPTION THIN ALUM. SHEET ADHESIVE BONDED TOGETHER. INFLATABLE RUBBER TUBE USED TO FORM INTEGRAL STIFFENERS; REMOVED AFTER CURE.	
APPLICATION TENSION SKIN	
MATERIALS ALUMINUM OR TITANIUM	
LOAD RANGE	
CONCEPT FEATURES ADVANTAGES ~ 1. FAIL SAFE DESIGN (CRACK ARREST) 2. REINFORCEMENT SIMPLE - ADD EXTRA PLIES 3. PLANE STRESS TOUGHNENING FROM THIN SHEETS DISADVANTAGES ~ 1. DIFFICULT TO BOND LARGE FLAT AREAS.	
PREPARED BY J. D. Bigler	DATE 6/13/72
GENERAL DYNAMICS Convair Aerospace Division Fort Worth Operation	



STRUCTURAL CONCEPT 610-101

TITLE SKIN PANEL - LOWER WING, STIFFENED

CONCEPT DESCRIPTION
SPAR STUBS AND STIFFENERS (THICKNESS TAPERED SPANWISE) ATTACHED TO SKIN BY CONTINUOUS SEAM DIFFUSION BONDING

APPLICATION WING TENSION SKIN

MATERIALS TITANIUM

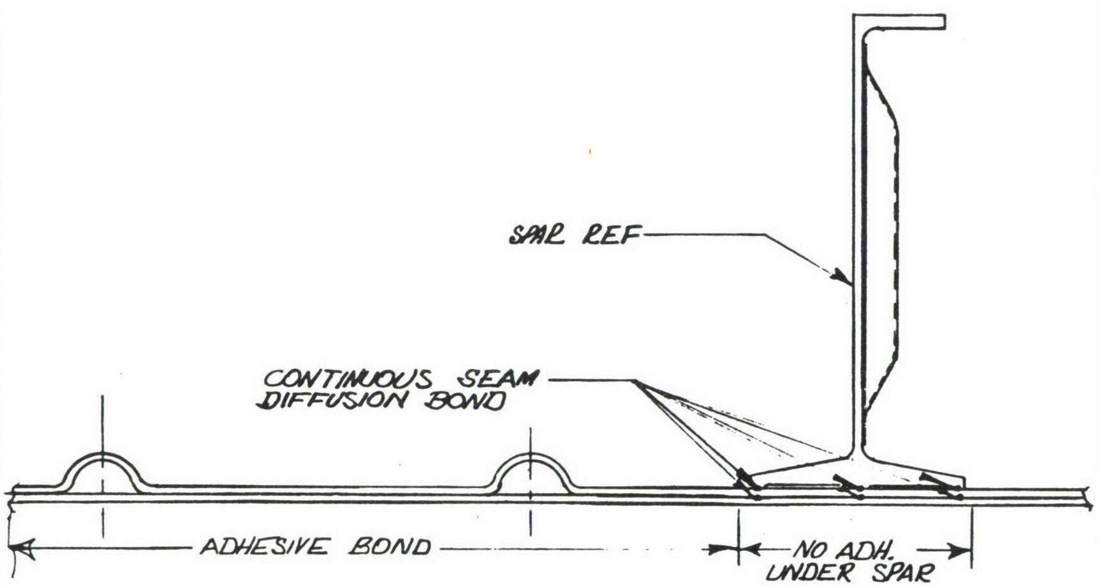
LOAD RANGE

CONCEPT FEATURES

- ACCOMMODATES SPANWISE TAPER IN ALL ELEMENTS
- MINIMIZES WASTED MATERIAL BY ELIMINATING MACHINING
- LARGE, ONE-PIECE PANELS CAN BE MADE

PREPARED BY D. E. Bloom DATE 6.15.72

GENERAL DYNAMICS
Convair Aerospace Division
Fort Worth Operation



STRUCTURAL CONCEPT

610-102

TITLE SKIN – LOWER TENSION, BEADED & DIFFUSION BONDED TO SPARS

CONCEPT DESCRIPTION LOWER TENSION SKIN CONCEPT WITH BEADED INNER SKIN & BOTH SKINS DIFFUSION BONDED TO SPARS THEREBY ELIMINATING FASTENER HOLES AND MINIMIZING K_T AT HOLES.

APPLICATION LOWER SKIN REACTING HIGH CYCLIC TENSION LOAD, MEDIUM COMP. & SHEAR.

MATERIALS TITANIUM ALLOY

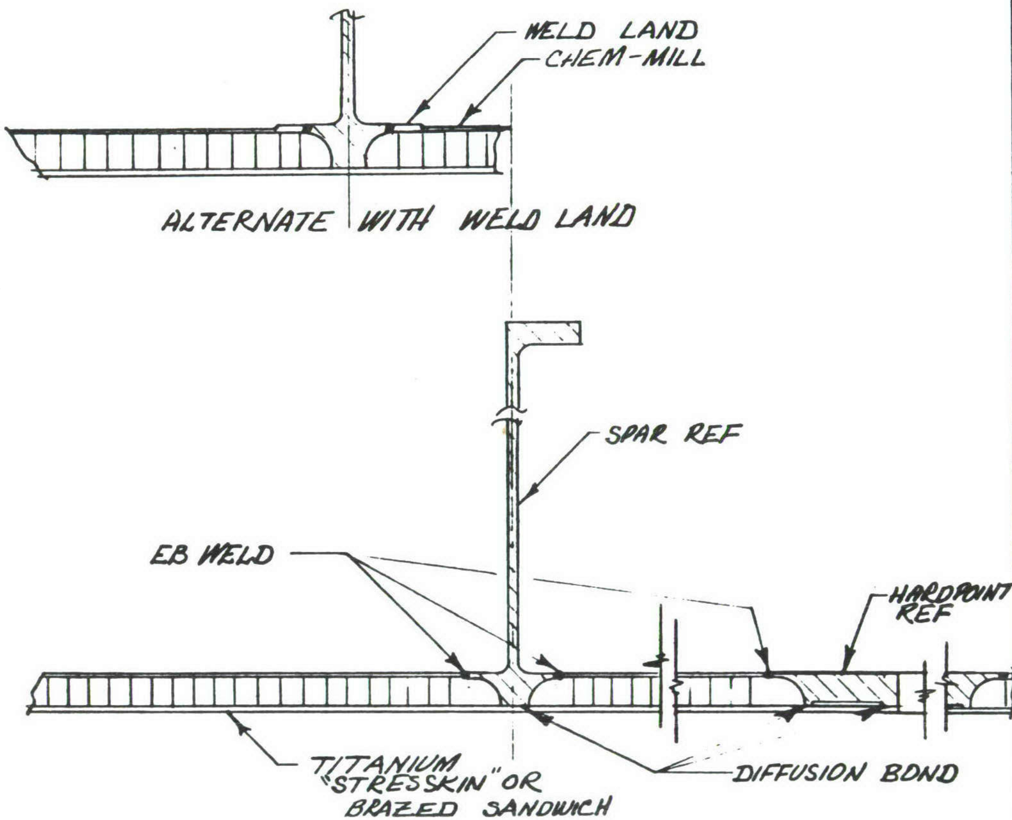
LOAD RANGE 1000 – 25,000# IN TENSION

CONCEPT FEATURES

- ELIMINATES FASTENERS & RESULTING HIGH K_t AT FASTENER HOLES
- HAS FAIL SAFE CHARACTERIC BECAUSE OF TWO SKINS
- BEADS WILL STABILIZE FOR SHEAR & MEDIUM COMPRESSION LOAD

PREPARED BY [signature] DATE 6-15-72

GENERAL DYNAMICS
Convair Aerospace Division
Fort Worth Operation



STRUCTURAL CONCEPT 610-103

TITLE SKIN - LOWER SANDWICH, DIFFUSION BOND & WELD ATTACHED SPARS & HARD POINTS

CONCEPT DESCRIPTION LOWER SKIN CONCEPT UTILIZING STRESSKIN OR BRAZED Ti SANDWICH WITH SPARS ATTACHED TO OUTER SKIN BY DIFFUSION BONDING & TO INNER SKIN BY EB WELD TO ELIMINATE FATENER HOLES & HIGH K_T.

APPLICATION LOWER SKIN REACTING HIGH TEN. CYCLIC LOAD WITH SIGNIFICANTLY HIGH SHEAR & COMP. LOADS COMBINED WITH HIGH TRANS[illegible]

MATERIALS Ti ALLOY

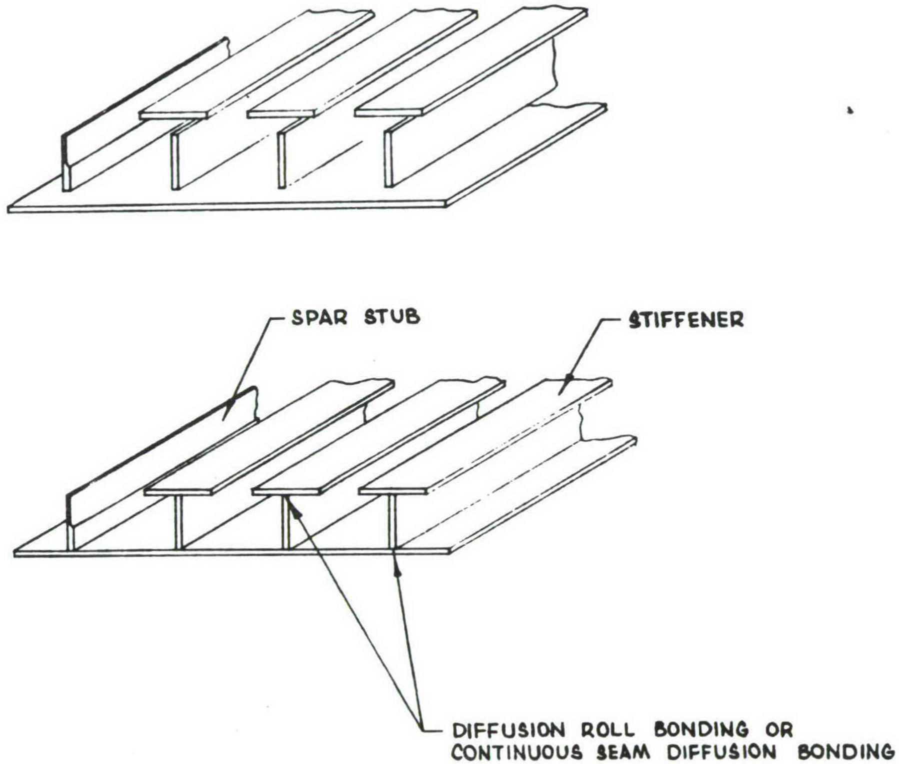
LOAD RANGE 1000 - 25,000 #/IN AXIAL LOAD
100 - 10,000 #/IN SHEAR

CONCEPT FEATURES

- ELIMINATES FASTENERS & RESULTING HIGH K_T AT FASTENER HOLES.
- TWO SKINS PROVIDES TWO LOAD PATHS.
- GOOD LOCAL STABILITY FOR SHEAR & COMPRESSION

PREPARED BY [signature] DATE 6-15-72

GENERAL DYNAMICS
Convair Aerospace Division
Fort Worth Operation



STRUCTURAL CONCEPT — 610-104

TITLE SKIN PANEL - WING LOWER, STIFFENED

CONCEPT DESCRIPTION
DIFFUSION BOND STRUCTURAL ELEMENTS (SUCH AS STIFFENERS AND SPAR STUBS) TO SKINS

APPLICATION
WING TENSION SKIN

MATERIALS TITANIUM

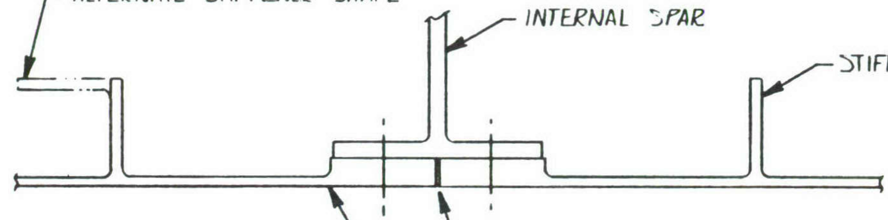
LOAD RANGE

CONCEPT FEATURES

- ELIMINATES THE LABOR AND THE WASTED MATERIAL ASSOCIATED WITH MACHINING INTEGRALLY STIFFENENED SKINS
- ELIMINATES THE HOLES FOR MECHANICAL FASTENERS IN TENSION SKINS

PREPARED BY D. E. Baum **DATE** 6.15.72

GENERAL DYNAMICS
Convair Aerospace Division
Fort Worth Operation



STRUCTURAL CONCEPT 610-105

TITLE PLANKED SKIN, INTEGRAL STIFFENERS

CONCEPT DESCRIPTION SEPARATE PLANKS SPAN BETWEEN ADJACENT SPARS. MACHINED FROM FORGED BLANKS.

APPLICATION
TENSION SKIN

MATERIALS
ALUMINUM OR TITANIUM

LOAD RANGE

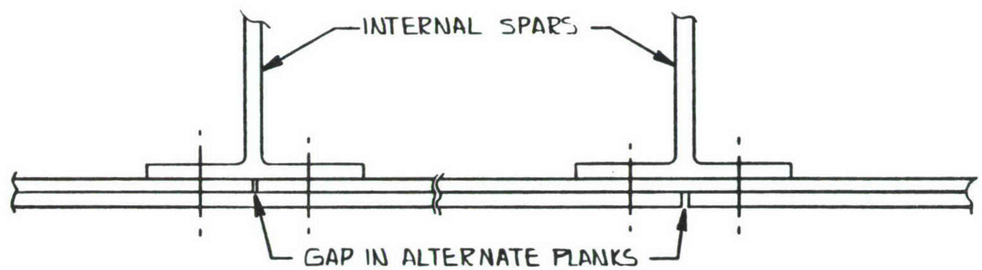
CONCEPT FEATURES

ADVANTAGES ~
1. FAIL SAFE DESIGN
2. STIFFENER SHAPE CAN BE VARIED AS REQ'D
3. EASY REPAIR

DISADVANTAGES ~
1. CHORDWISE LOADS MUST GO FROM PLANK INTO SPAR CAP AND THEN FROM SPAR CAP TO ADJACENT PLANK.

PREPARED BY J.D. Bixler | DATE 6/16/72

GENERAL DYNAMICS
Convair Aerospace Division
Fort Worth Operation



STRUCTURAL CONCEPT 610-106

TITLE PLANKED SKIN. ALTERNATING GAP

CONCEPT DESCRIPTION TWO OR MORE SHEETS SPAN BETWEEN THREE ADJACENT SPARS. GAP IS ALTERNATED SO AT LEAST ONE SHEET IS CONTINUOUS.

APPLICATION
TENSION SKIN

MATERIALS
ALUMINUM OR TITANIUM

LOAD RANGE

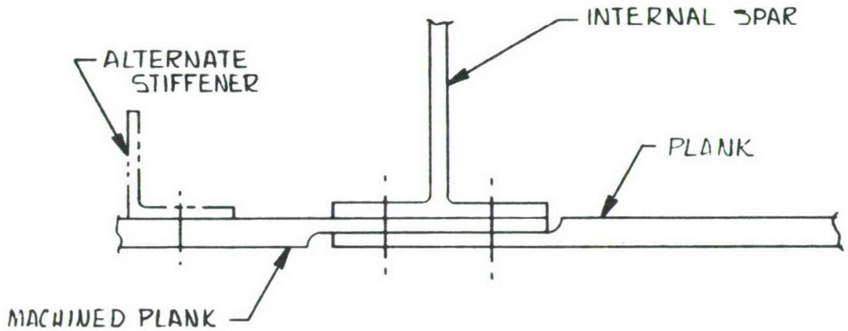
CONCEPT FEATURES

ADVANTAGES~
1. FAIL SAFE DESIGN
2. MINIMUM MACHINING OF SKINS
3. CONTINUITY OF SHEETS IMPROVES CHORDWISE BENDING STRENGTH.

DISADVANTAGES~
1. NOT STABLE IN COMPRESSION

PREPARED BY J. D. Rixler DATE 6/16/72

GENERAL DYNAMICS
Convair Aerospace Division
Fort Worth Operation



STRUCTURAL CONCEPT 610-107

TITLE PLANKED SKIN, OVERLAP JOINT

CONCEPT DESCRIPTION EACH PLANK SPANS BETWEEN ADJACENT SPARS. STIFFENERS CAN BE ADDED IF REQUIRED

APPLICATION
TENSION SKIN

MATERIALS
ALUMINUM OR TITANIUM

LOAD RANGE

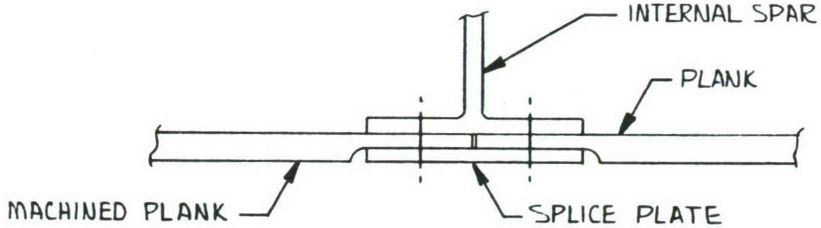
CONCEPT FEATURES

ADVANTAGES ~
1. FAIL SAFE DESIGN
2. CONTINUITY ACROSS JOINT CHORDWISE
3. FACILITATES SKIN STIFFENING

DISADVANTAGES ~

PREPARED BY [signature] DATE 6/16/72

GENERAL DYNAMICS
Convair Aerospace Division
Fort Worth Operation



STRUCTURAL CONCEPT 610-108

TITLE PLANKED SKIN, SPLICE PLATE

CONCEPT DESCRIPTION SEPARATE PLANKS SPAN BETWEEN ADJACENT SPARS. SPAR CAP AND SPLICE PLATE TIE PLANKS TOGETHER. STIFFENERS CAN BE ADDED IF REQ'D.

APPLICATION
TENSION SKIN

MATERIALS
ALUMINUM AND TITANIUM

LOAD RANGE

CONCEPT FEATURES

ADVANTAGES~
1. FAIL SAFE DESIGN
2. CONTINUITY ACROSS JOINT CHORDWISE

DISADVANTAGES~

PREPARED BY J.D. Bixler DATE 6/16/72

GENERAL DYNAMICS
Convair Aerospace Division
Fort Worth Operation

STRUCTURAL CONCEPT — 610-109

TITLE SKIN~SANDWICH ADHESIVE BONDED WITH SPAR CAPS DIFFUSION BONDED TO SKINS

CONCEPT DESCRIPTION AN ADHESIVE BONDED PANEL CONCEPT THAT PROVIDES POSITIVE ATTACHMENT OF SPAR CAPS BY CONTINUOUS SEAM DIFFUSION BONDING TO ELIMINATE MECH. FASTENERS

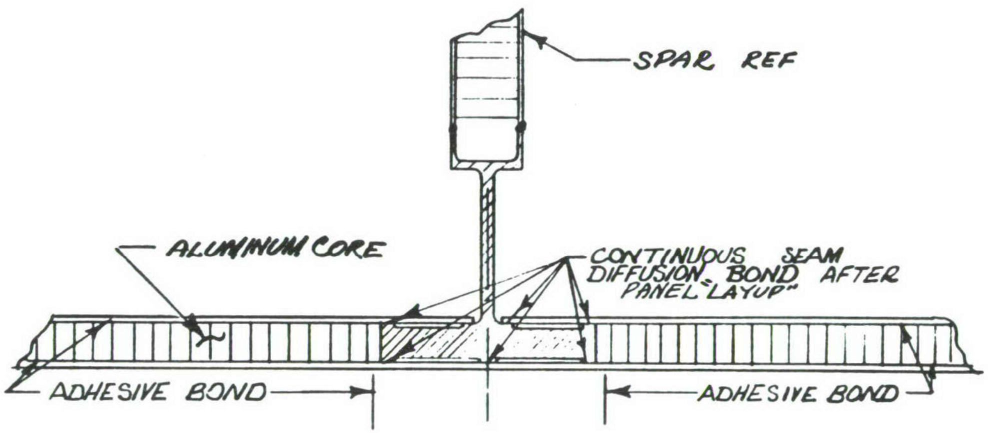
APPLICATION LOWER SKIN WITH HIGH CYCLIC TENSION LOAD & HIGH COMPRESSION LOAD

MATERIALS TITANIUM SPAR & FACE SHEETS ALUMINUM CORE

LOAD RANGE 1000 – 25,000 #/IN AXIAL LOAD

CONCEPT FEATURES

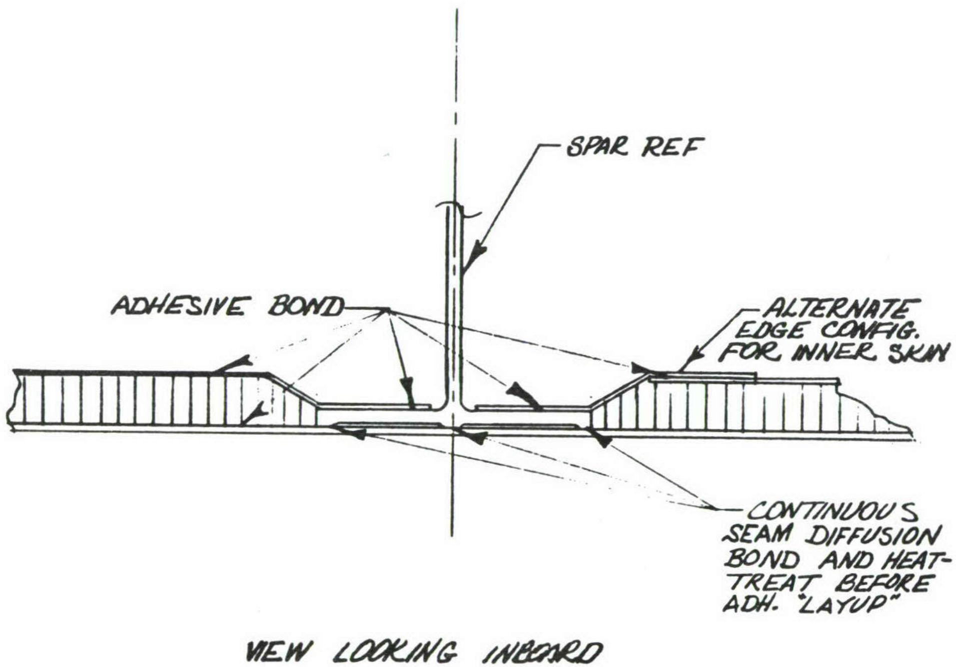
- OPTIMUM SHEAR & COMPRESSION STABILITY
- LOW K_T BY ELIMINATING FASTENERS – HENCE, HIGH FATIGUE ALLOWABLE STRESS



VIEW LOOKING INBOARD

PREPARED BY R.W. McNally DATE 6-16-72

GENERAL DYNAMICS
Convair Aerospace Division
Fort Worth Operation



STRUCTURAL CONCEPT 610-110

TITLE SKIN~SANDWICH, LOWER ADHESIVE BONDED HONEY COMB WITH SPAR DIFFUSION BONDED TO OUTER SKIN

CONCEPT DESCRIPTION ADH. BONDED HONEY COMB LOWER SANDWICH SKIN CONCEPT THAT ATTACHES SPAR CAPS TO LOWER SKIN BY DIFFUSION BONDING ALLOWING HEAT TREAT BEFORE ADH. BOND "LAYUP". FASTENERS ARE ELIMINATED

APPLICATION LOWER SKIN APPLICATION WITH HIGH CYCLIC TENSION LOAD PLUS HIGH COMPRESSION LOAD AND INTERNAL PRESS.

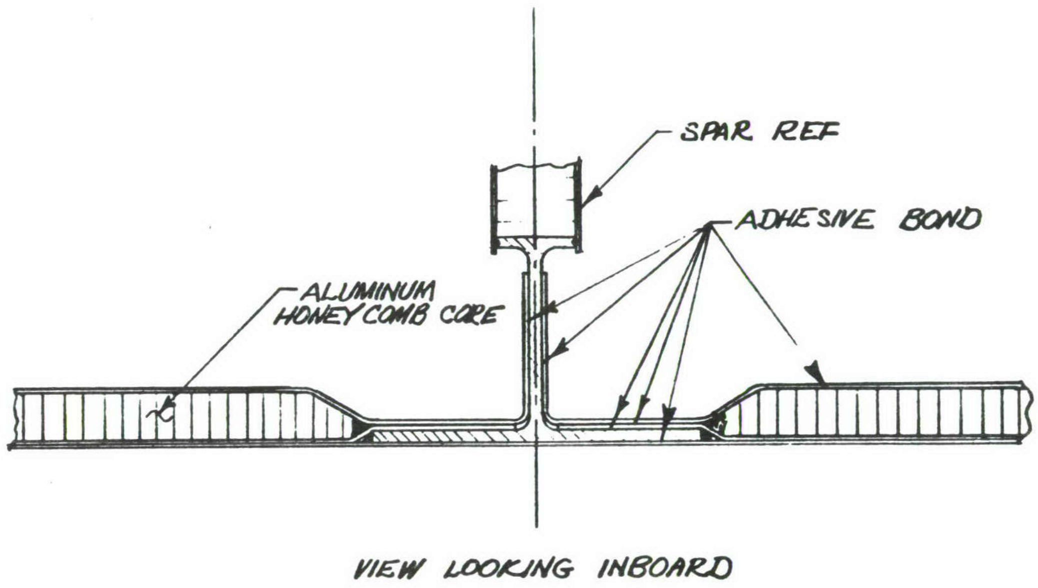
MATERIALS TITANIUM ALLOY

LOAD RANGE 1000 TO 25000 #/IN AXIAL LOAD
100-10000 #/IN SHEAR LOAD

CONCEPT FEATURES
- GOOD SHEAR & COMPRESSION STABILITY
- POSITIVE ATTACHMENT BETWEEN SPAR CAPS & SKIN
- LOW K_T BY ELIMINATING FASTENER HOLES—HENCE HIGH FATIGUE ALLOW. STRESS.

PREPARED BY R.W. McAnally DATE 6-16-72

GENERAL DYNAMICS
Convair Aerospace Division
Fort Worth Operation



STRUCTURAL CONCEPT 610-111

TITLE SKIN ~ SANDWICH, LOWER ADHESIVE BONDED WITH INTEGRAL SPAR CAPS

CONCEPT DESCRIPTION LOWER ~ BONDED HONEYCOMB SANDWICH SKIN CONCEPT THAT INTEGRATES SPARS BY ADHESIVE BONDING. FASTENERS ARE ELIMINATED

APPLICATION LOWER SKIN APPLICATION WITH HIGH CYCLIC TENSION LOAD PLUS HIGH COMPRESSION LOAD & INTERNAL PRESS.

MATERIALS ALUMINUM & TITANIUM ALLOYS

LOAD RANGE 1000 – 25000 #/IN AXIAL LOAD
100 – 10000 #/IN SHEAR

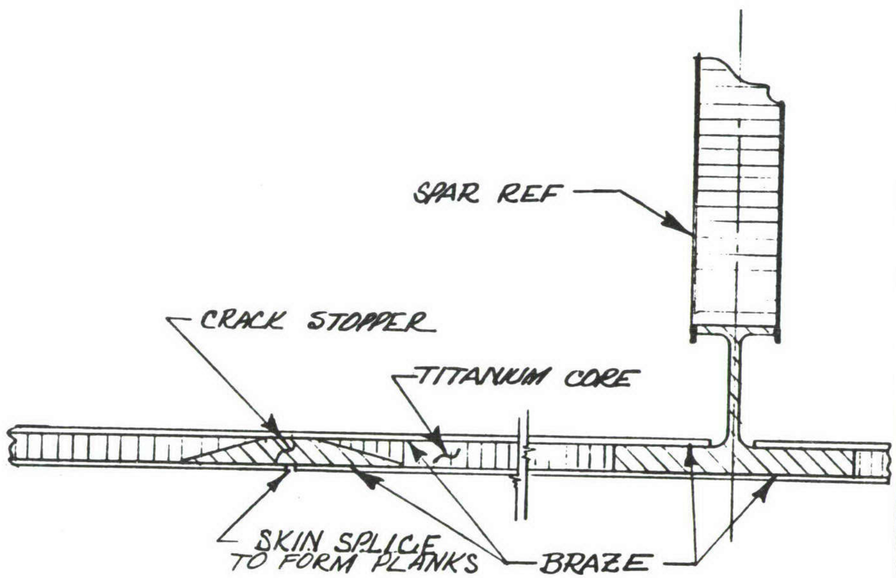
CONCEPT FEATURES

- GOOD SHEAR & COMPRESSION STABILITY
- LOW K_T BY ELIMINATING FASTENER HOLES – HENCE, HIGH FATIGUE ALLOW. STRESS.

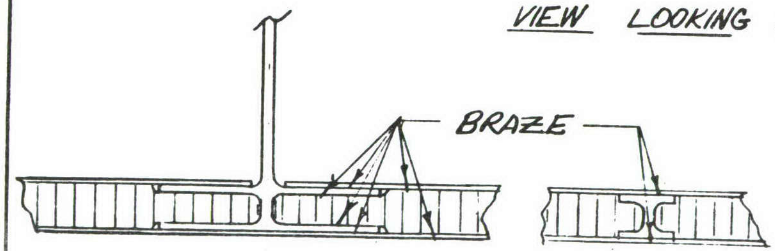
PREPARED BY R.W. McAnally DATE 6-16-72

GENERAL DYNAMICS
Convair Aerospace Division
Fort Worth Operation

STRUCTURAL CONCEPT	610-112
TITLE SKIN~SANDWICH, BRAZED HONEY-COMB CORE WITH CRACK STOPPERS AND INTERGAL SPAR CAPS	
CONCEPT DESCRIPTION CONCEPT CONSISTS OF A BRAZED HONEY COMB SANDWICH PANEL WITH SKIN PLANKS & SPAR CAPS BRAZED INTO PANEL. FASTENERS ARE ELIMINATED. TO PROVIDE LOW K_T.	
APPLICATION SKIN WITH HIGH CYCLIC TENSION LOAD AND MED. SHEAR & COMPRESSION	
MATERIALS TITANIUM OR STEEL	
LOAD RANGE 1000 TO 50,000 #/in AXIAL LOAD 500 TO 20,000 #/in SHEAR	
CONCEPT FEATURES • CONCEPT HAS FAIL SAFE FEATURE WITHOUT A WEIGHT PENALTY • GOOD HIGH TEMP RESISTANCE • ELIMATION OF FASTENERS RESULTS IN LOW K_T HENCE HIGH FATIGUE ALLOW. • HARD POINT REQTS. MAY BE ADDED WITHOUT HIGH WT. OR COST PENALTY	
PREPARED BY R.W. McCarthy	DATE 6-16-72
GENERAL DYNAMICS Convair Aerospace Division Fort Worth Operation	



VIEW LOOKING INBOARD



ALTERNATE SPAR & CRACK-STOPPER CROSS-SECTIONS

STRUCTURAL CONCEPT 610 113

TITLE SKIN—LOWER, BRAZED CRACK STOPPER CONFIG. WITH INTEGRAL SPARS

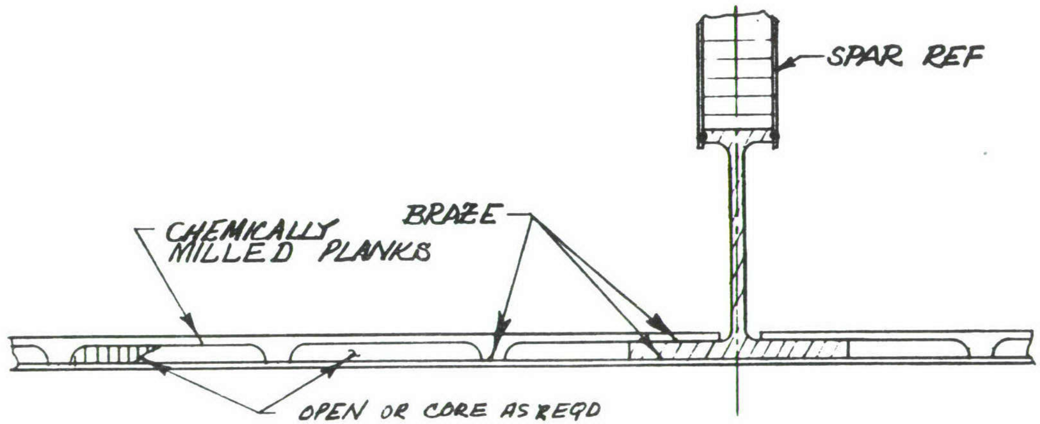
CONCEPT DESCRIPTION TWO LAYER BRAZED SKIN CONCEPT WITH CHEMICALLY MILLED LANDS ON INNER SKIN ACTING AS CRACK STOPPERS & STABILIZING MEMBERS - FASTENERS ARE ELIMINATED

APPLICATION LOWER SKIN WITH HIGH CYCLIC TENSION LOADS & MEDIUM COMPRESSION & SHEAR.

MATERIALS TITANIUM OR STEEL

LOAD RANGE 1800 — 40,000 #/IN TENSION

CONCEPT FEATURES
- LOW K_T — NO FASTENER HOLES
- FAIL SAFE/SAFE LIFE CHARACTERISTICS BECAUSE OF TWO SKINS & CRACK STOPPERS.
- HARD POINTS CAN BE INCORPORATED WITH EASE & GOOD EFFICIENCY
- PROVIDES SMOOTH TANK LOWER SURFACE WITHOUT POCKETS



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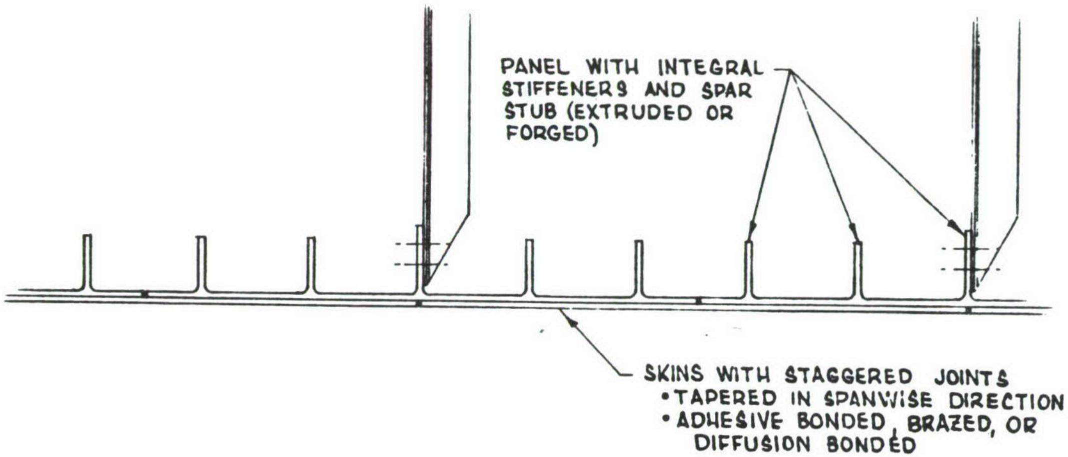
PREPARED BY [signature] DATE 6-19-72

GENERAL DYNAMICS
Convair Aerospace Division
Fort Worth Operation



STRUCTURAL CONCEPT 610-114

TITLE SKIN - INTEGRALLY STIFFENED, PLANKED, STAGGERED JOINT

CONCEPT DESCRIPTION INTEGRALLY STIFFENED INNER MEMBER ATTACHED TO FLAT SKIN IN AN ARRANGEMENT WITH STAGGERED SPANWISE JOINTS

APPLICATION WING TENSION SKIN

MATERIALS ALUMINUM, TITANIUM

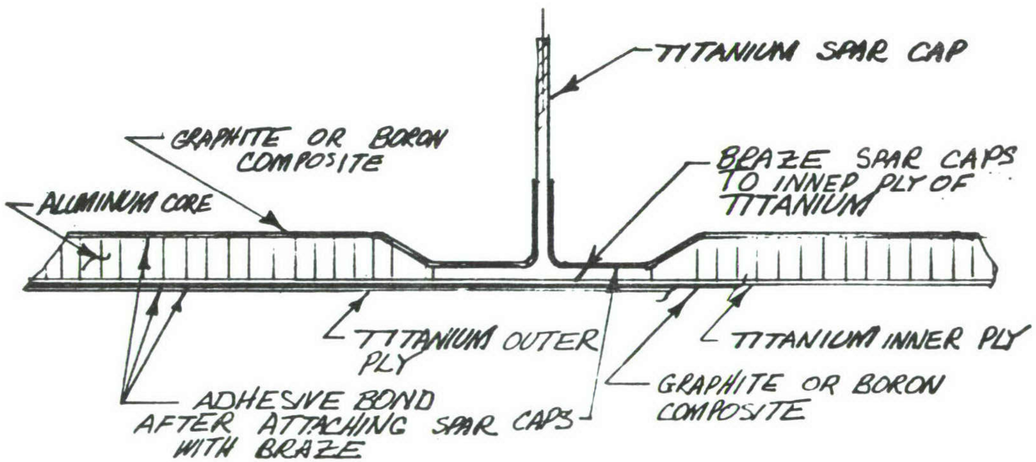
LOAD RANGE

CONCEPT FEATURES

- NO FASTENERS IN TENSION SKINS
- STAGGERED JOINTS PROVIDE A FAIL SAFE FEATURE
- MACHINING IS ELIMINATED (OR MINIMIZED)

PREPARED BY D. E. Boon DATE 6·19·72

GENERAL DYNAMICS
Convair Aerospace Division
Fort Worth Operation



STRUCTURAL CONCEPT 610-115

TITLE SKIN ~ SANDWICH Ti/COMPOSITE LAMINATE WITH SPAR CAPS BRAZED TO INNER PLY OF TITANIUM

CONCEPT DESCRIPTION SANDWICH SKIN CONCEPT THAT UTILIZES BRAZE TO ATTACH SPAR CAPS & TITANIUM/COMPOSITE LAMINATE OUTER SKIN WITH INNER SKIN OF COMPOSITE TO STABILIZE THE PANEL

APPLICATION LOWER SKIN WITH HIGH CYCLIC TENSION LOAD PLUS SIGNIFICANT SHEAR & COMPRESSION LOADS.

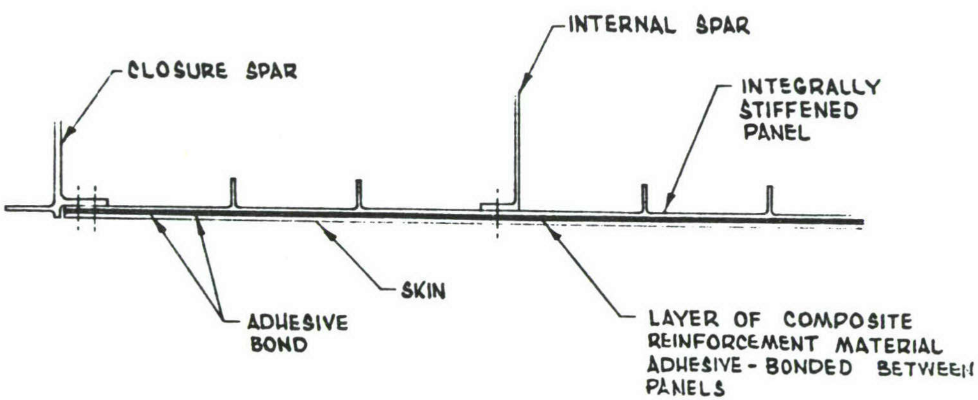
MATERIALS TITANIUM/ BORON OR GRAPHITE COMPOSITE

LOAD RANGE 1000 — 25000 #/in AXIAL LOAD 100 - 15000 #/in SHEAR

CONCEPT FEATURES
- MINIMUM WT.
- POSITIVE TENSION & SHEAR TIE OF SPAR TO OUTER SKIN
- GOOD COMPRESSION & SHEAR STABILITY
- NO FASTENERS THRU HIGH TENSION LOAD AREA - LOW K_T - HIGH FATIGUE STRESS ALLOWABLE
- MULTIPLE LOAD PATHS - FAIL SAFE CHARACTERISTICS

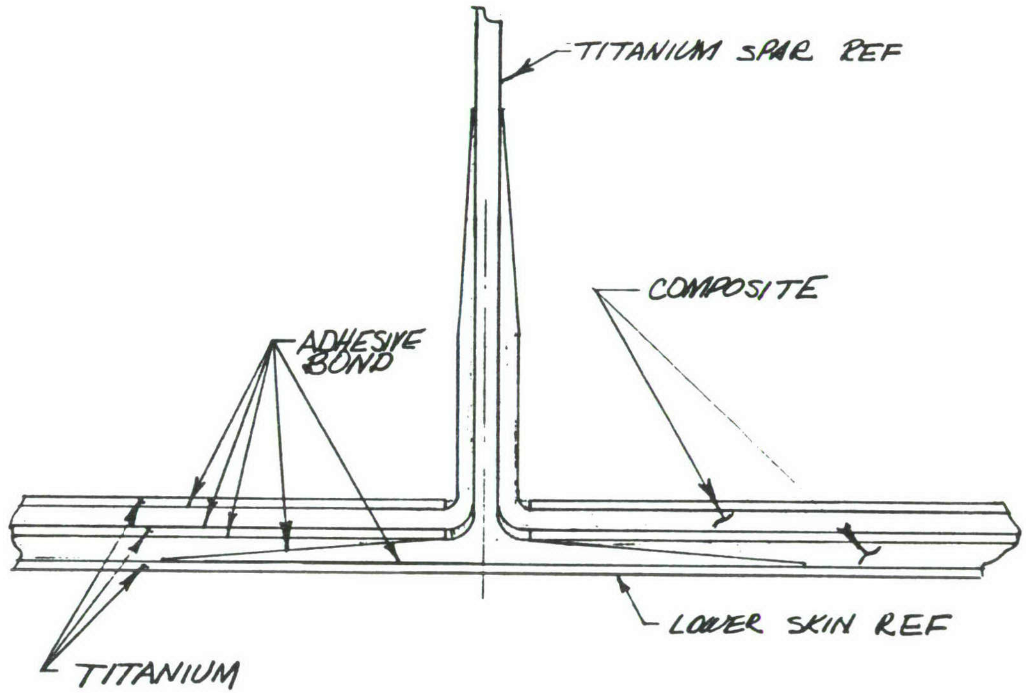
PREPARED BY R.A. McCord **DATE** 6-21-72

GENERAL DYNAMICS
Convair Aerospace Division
Fort Worth Operation



ALTERNATE

STRUCTURAL CONCEPT	610-116
TITLE SKIN PANEL - INTEGRALLY STIFFENED, COMPOSITE REINFORCED	
CONCEPT DESCRIPTION FLAT OUTER SKIN IS REINFORCED BY A LAYER OF COMPOSITE MAT'L. BONDED BETWEEN IT AND AN INTEGRALLY STIFFENED INNER PANEL	
APPLICATION WING TENSION SKIN	
MATERIALS ALUMINUM, TITANIUM	
LOAD RANGE	
CONCEPT FEATURES • WEIGHT SAVING • MINIMUM NUMBER OF FASTENERS THROUGH TENSION SKIN • SIMPLE METHOD OF PROVIDING LOCALIZED STRENGTHENING OF SKINS	
PREPARED BY J. E. Bloom	DATE 6·21·72
GENERAL DYNAMICS Convair Aerospace Division Fort Worth Operation	



STRUCTURAL CONCEPT

610-117

TITLE SKIN ~ TITANIUM/COMPOSITE BONDED LAMINATE WITH INTEGRAL SPAR

CONCEPT DESCRIPTION TITANIUM/COMPOSITE ADHESIVE BONDED LAMINATE THAT INTEGRATES SPARS WITHOUT MECHANICAL FASTENERS

APPLICATION LOWER SKIN PANEL WITH HIGH TENSION LOAD

MATERIALS TITANIUM & BORON OR GRAPHITE COMPOSITE

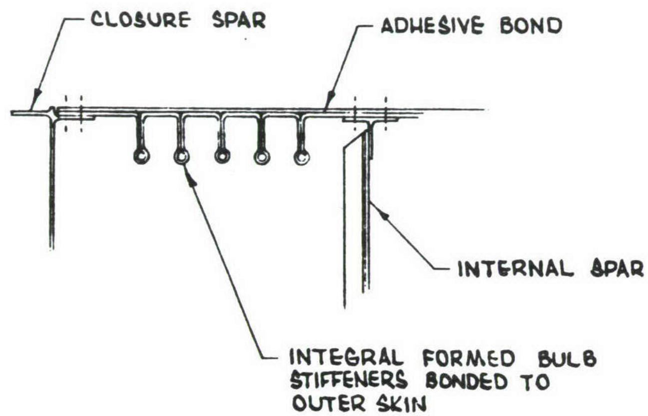
LOAD RANGE 1000 - 40000 #/IN

CONCEPT FEATURES

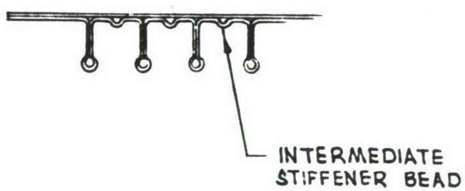
- LIGHT WEIGHT
- LOW K_T BY ELIMINATION OF MECHANICAL FASTENER HOLES

PREPARED BY R. W. McElhatty DATE 6-21-72

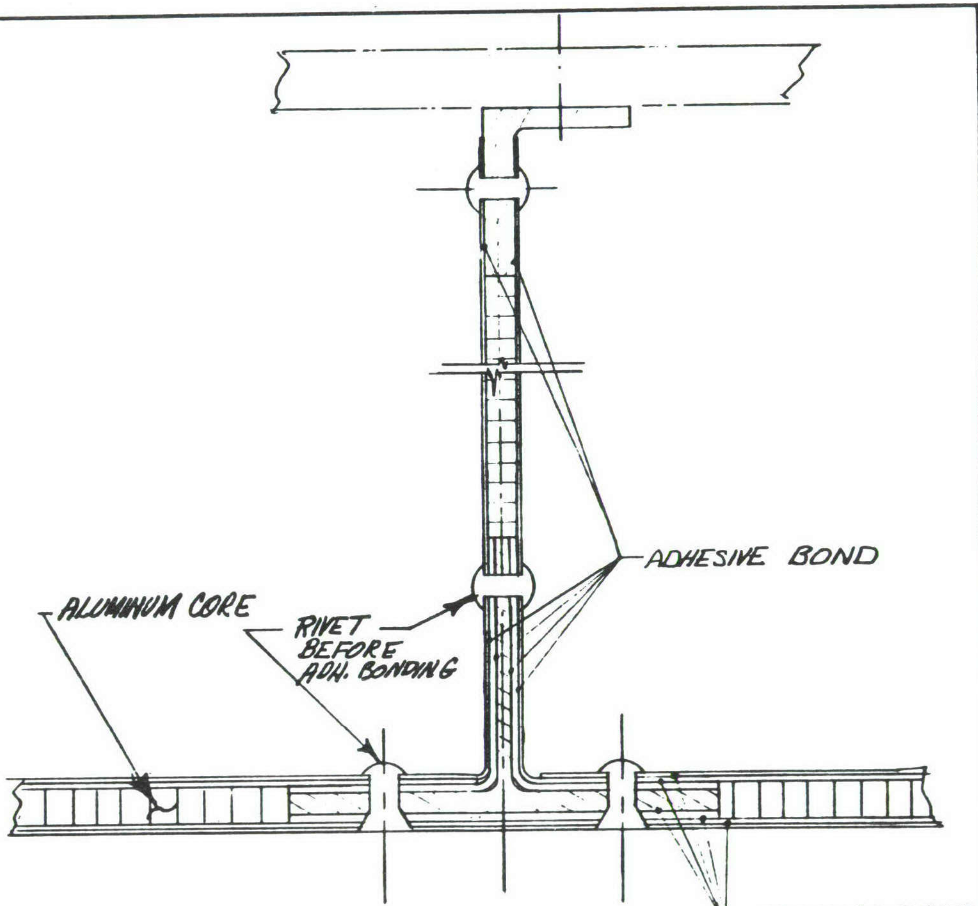
GENERAL DYNAMICS
Convair Aerospace Division
Fort Worth Operation



ALTERNATE

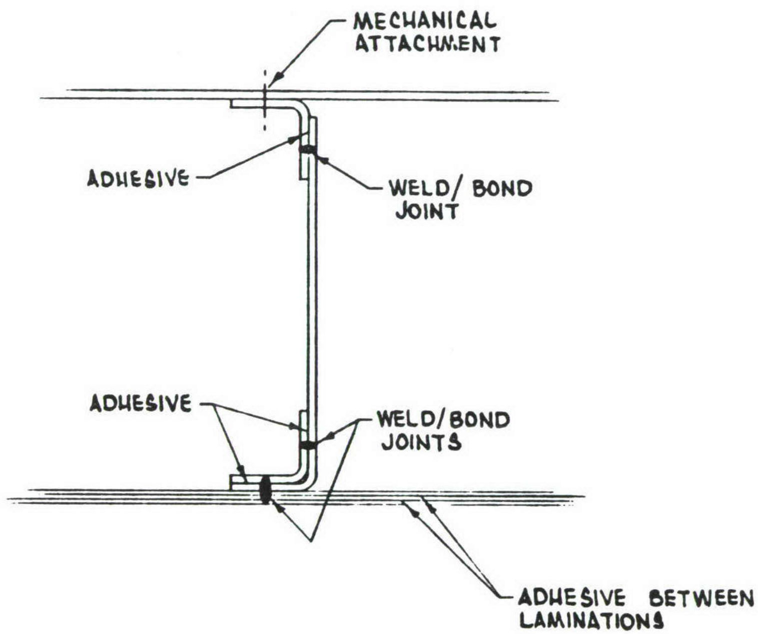


STRUCTURAL CONCEPT	610-118
TITLE SKIN PANEL - WING, FORMED BULB STIFFENER	
CONCEPT DESCRIPTION FLAT SKIN IS STIFFENED BY ADHESIVE BONDING TO IT INTEGRAL FORMED BULB STIFFENERS	
APPLICATION WING TENSION SKIN	
MATERIALS TITANIUM, STEEL, ALUMINUM	
LOAD RANGE	
CONCEPT FEATURES • LIGHT WEIGHT MEANS OF ACHEIVING PANEL RIGIDITY	
PREPARED BY S. E. Bloom	DATE 6-22-72
GENERAL DYNAMICS *Convair Aerospace Division* *Fort Worth Operation*	



STRUCTURAL CONCEPT	610-119
TITLE SKIN - LOWER, ADHESIVE BONDED/RIVETED SANDWICH WITH INTEGRAL SPAR	
CONCEPT DESCRIPTION LOWER SKIN SING COMBINATION OF LAMINATED SHEETS, ADH BONDED WITH RIVETS ADDED AS A BACK UP JOINING SYSTEM.	
APPLICATION LOWER SKIN WITH HIGH TENSION LOAD - SIGNIFICANT SHEAR & COMPRESSION LOAD.	
MATERIALS TITANIUM & ALUMINUM ALLOY	
LOAD RANGE 1000 - 25,000#/IN AXIAL LOAD 100 - 10000#/IN SHEAR FLOW	
CONCEPT FEATURES • IMPROVED K_T WITH ADHESIVE BOND AROUND FASTENER HOLES • GOOD COMPRESSION & SHEAR STABILITY • LAMINATES PROVIDE FAIL - SAFE CHARACTERISTICS	
PREPARED BY R.W. McAnally	DATE 6-26-72

GENERAL DYNAMICS
Convair Aerospace Division
Fort Worth Operation



STRUCTURAL CONCEPT 610-120

TITLE SKIN-LAMINATED (WITH WELD/BOND ATTACHMENTS)

CONCEPT DESCRIPTION
WING SKIN MADE UP OF ALUMINUM SHEETS ADHESIVE-BONDED TOGETHER, THEN WELD/BONDED TO THE UNDERSTRUCTURE

APPLICATION WING TENSION SKIN (WELD/ BONDED SPAR ALSO DEPICTED)

MATERIALS TITANIUM, ALUMINUM

LOAD RANGE

CONCEPT FEATURES

- FAIL SAFE
- PANEL THICKNESS MAY BE TAPERED (SPANWISE AND CHORDWISE) AND LOCALLY BUILT UP WITHOUT THICK PLATE MACHINING
- ELIMINATES FASTENER HOLES THROUGH TENSION SKIN

PREPARED BY D. E. Broom DATE 6·26·72

GENERAL DYNAMICS
Convair Aerospace Division
Fort Worth Operation

STRUCTURAL CONCEPT 610-121

TITLE SKIN PANEL - LOWER WING STIFFENED AND LAMINATED

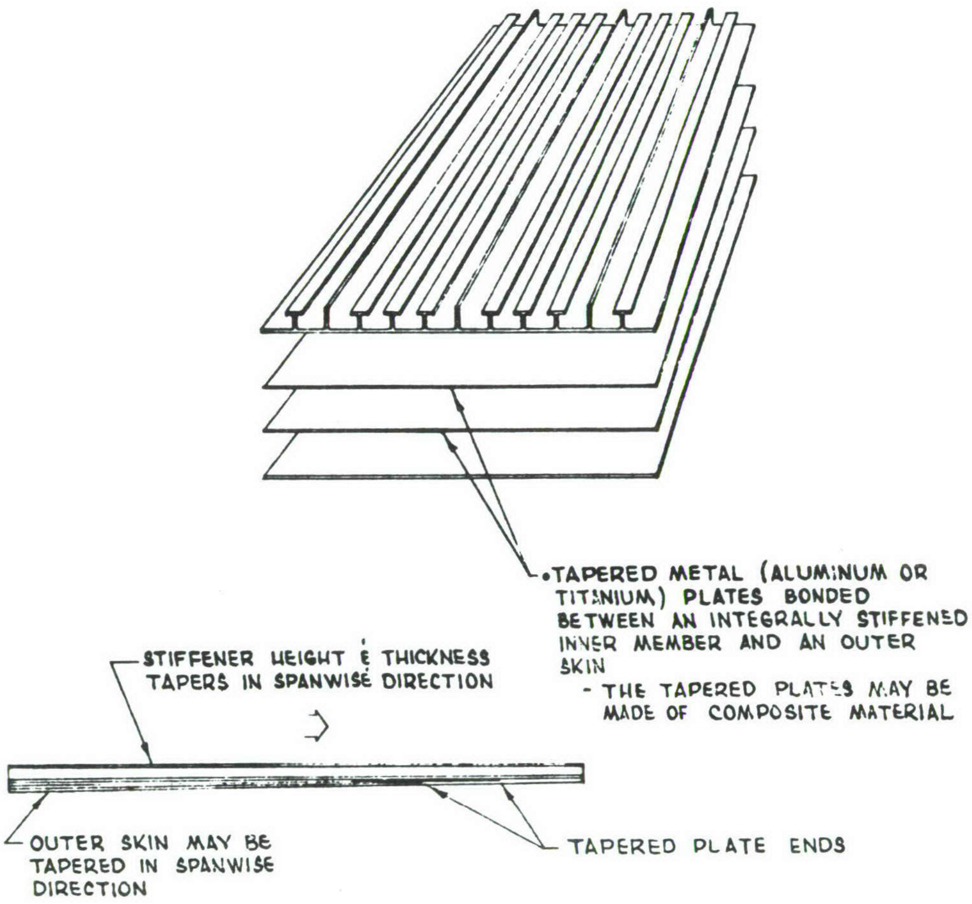
CONCEPT DESCRIPTION
CONCEPT COMBINES ROLL-TAPERED SKINS, TAPERED EXTRUSIONS, INTEGRAL STIFFENING, & BONDED LAMINATIONS IN ONE PANEL

APPLICATION
WING TENSION SKIN

MATERIALS ALUMINUM, TITANIUM

LOAD RANGE

CONCEPT FEATURES
- COMBINATION OF DESIGN CONCEPTS YEILDS GOOD STRENGTH/WEIGHT RATIO
- FAIL-SAFE



PREPARED BY [signature] DATE 6-29-72

GENERAL DYNAMICS
Convair Aerospace Division
Fort Worth Operation

STRUCTURAL CONCEPT — 610-122

TITLE SKIN ~ BETA III TITANIUM HEAT-TREATED TO HAVE LOW "E" IN AREA OF FASTENER HOLES

CONCEPT DESCRIPTION UTILIZE LIQUID COOLED CHILL BARS TO QUENCH ATTACHMENT AREAS OF LOWER SKIN PANEL TO PRODUCE LOW MOD. OF ELASTICITY WHILE AGEING REMAINING AREAS TO HIGH "E" & MAX TENSILE STRENGTH

APPLICATION LOWER SKIN PANEL WITH HIGH CYCLIC TENSION LOAD

MATERIALS BETA III TITANIUM

LOAD RANGE HIGH CYCLIC TENSION LOAD

CONCEPT FEATURES

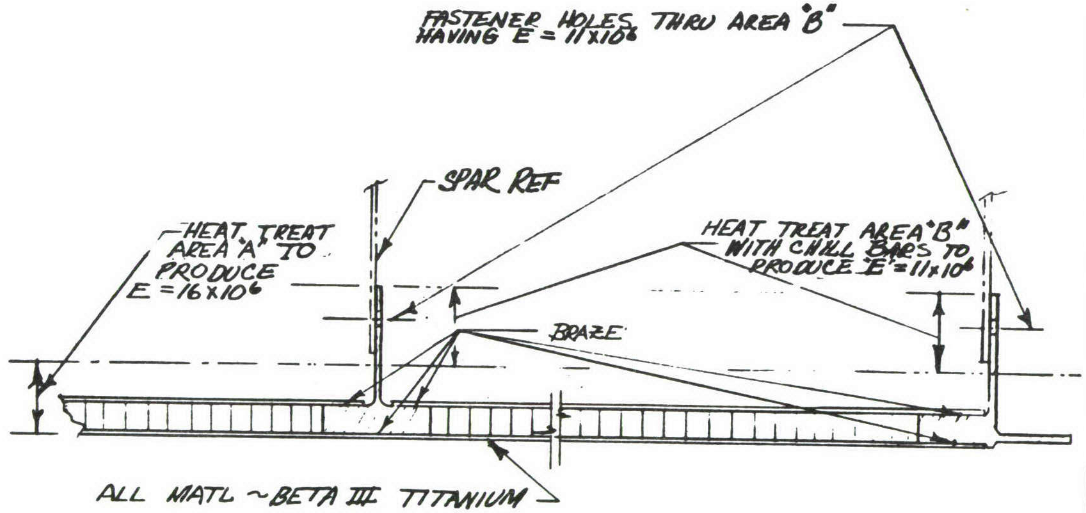
- HAVING THE LOW VALUE OF "E" IN THE ATTACHMENT AREA WILL RESULT IN LOW STRESS IN THE AREA HAVING HIGH K_T VALUES. THE AREAS WITH LOW K_T (NO FASTENER HOLES) AND HAVING HIGH "E" VALUE MAY BE OPERATED TO HIGH CYCLIC STRESSES.

EXAMPLE:

"E" FOR AREA "A" $= 16 \times 10^6$

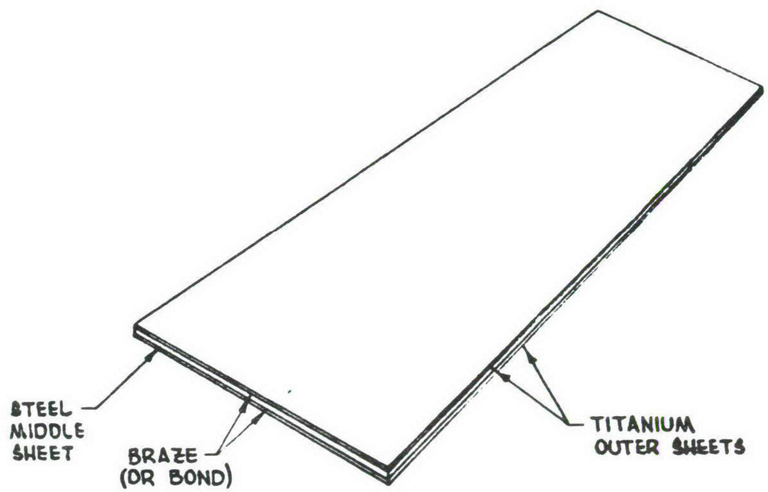
"E" FOR AREA "B" $= 11 \times 10^6$

WHEN STRESS IN AREA "A" IS 134,000 PSI; STRESS IN AREA "B" $= \frac{11}{16} \times 134{,}000 = 92{,}400$ PSI



PREPARED BY [signature] DATE 7/12/72

GENERAL DYNAMICS
Convair Aerospace Division
Fort Worth Operation



MANUFACTURING SEQUENCE

1. LAY UP THE OUTER TITANIUM SHEETS AND THE MIDDLE STEEL SHEET WITH BRAZE ALLOY FOIL SHEETS BETWEEN THEM.
2. APPLY UNIFORM PRESSURE TO THE ASSEMBLY TO HOLD THE SHEETS IN INTIMATE CONTACT WITH ONE ANOTHER.
3. RAISE THE TEMPERATURE OF THE ASSEMBLY ABOVE THE MELTING POINT OF THE BRAZE ALLOY AND STABILIZE AT THAT TEMPERATURE.
4. COOL TO AMBIENT TEMPERATURE BEFORE RELEASING PRESSURE.

STRUCTURAL CONCEPT 610-123

TITLE WING SKIN PANEL – BI-METAL

CONCEPT DESCRIPTION
TITANIUM AND STEEL SHEETS ARE BRAZED TOGETHER IN A MANNER WHICH PRODUCES RESIDUAL COMP. STRESS IN TI

APPLICATION
WING TENSION SKIN

MATERIALS STEEL (301, ½ H), TI (6-4, β)

LOAD RANGE

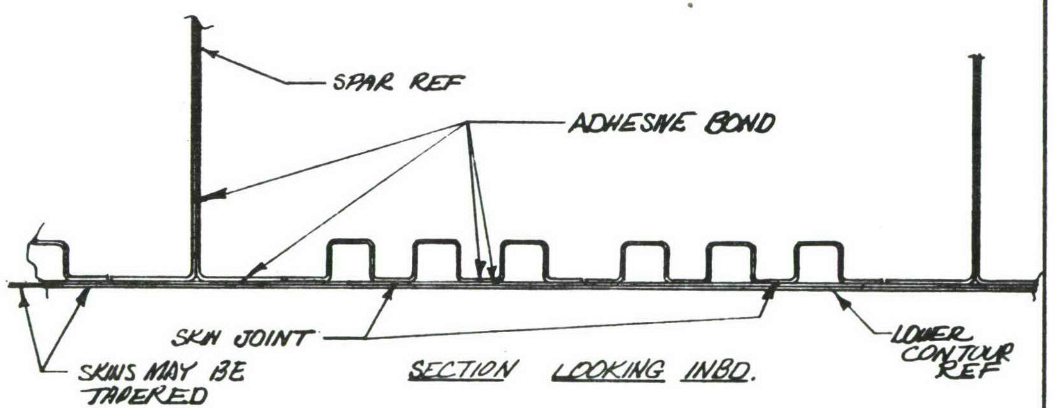
CONCEPT FEATURES

- BY LOW TEMP BRAZING* (~600-700°F) A STEEL (301, HALF HARD) SHEET BETWEEN TITANIUM SHEETS IN THE MANNER DESCRIBED A SKIN PANEL CAN BE PRODUCED WHEREIN THE TITANIUM SHEETS ARE IN ~20 KSI COMPRESSION AND THE STEEL SHEET IS IN ~40 KSI TENSION, THEREBY OFFERING IMPROVED FATIGUE RESISTANCE IN A SKIN PANEL LOADED PRIMARILY IN TENSION, I.E., WING LOWER SURFACE
- MULTI-SHEET CONSTRUCTION IS FAIL-SAFE

* OR ADHESIVE BONDING

PREPARED BY J. E. Bloom
CONCEIVED BY E. W. GOMEZ
DATE 7-12-72

GENERAL DYNAMICS
Convair Aerospace Division
Fort Worth Operation



STRUCTURAL CONCEPT 610-124

TITLE SKIN - LOWER ADHESIVE BONDED LAMINATE WITH CORRUGATED HAT STIFFENERS

CONCEPT DESCRIPTION
CONCEPT UTILIZES LAMINATED SKIN & LONGITUDINAL FLANKING OF SKINS & STIFFENER MEMBERS TO IMPROVE DAMAGE TOL. OF LOWER SKIN

APPLICATION LOWER WING SKIN

MATERIALS TITANIUM OR AL. SHEET

LOAD RANGE 1000 TO 20,000 #/IN

CONCEPT FEATURES
- HAS FAIL SAFE & DAMAGE TOLERANCE FEATURES
- ECONOMICAL TO FABRICATE

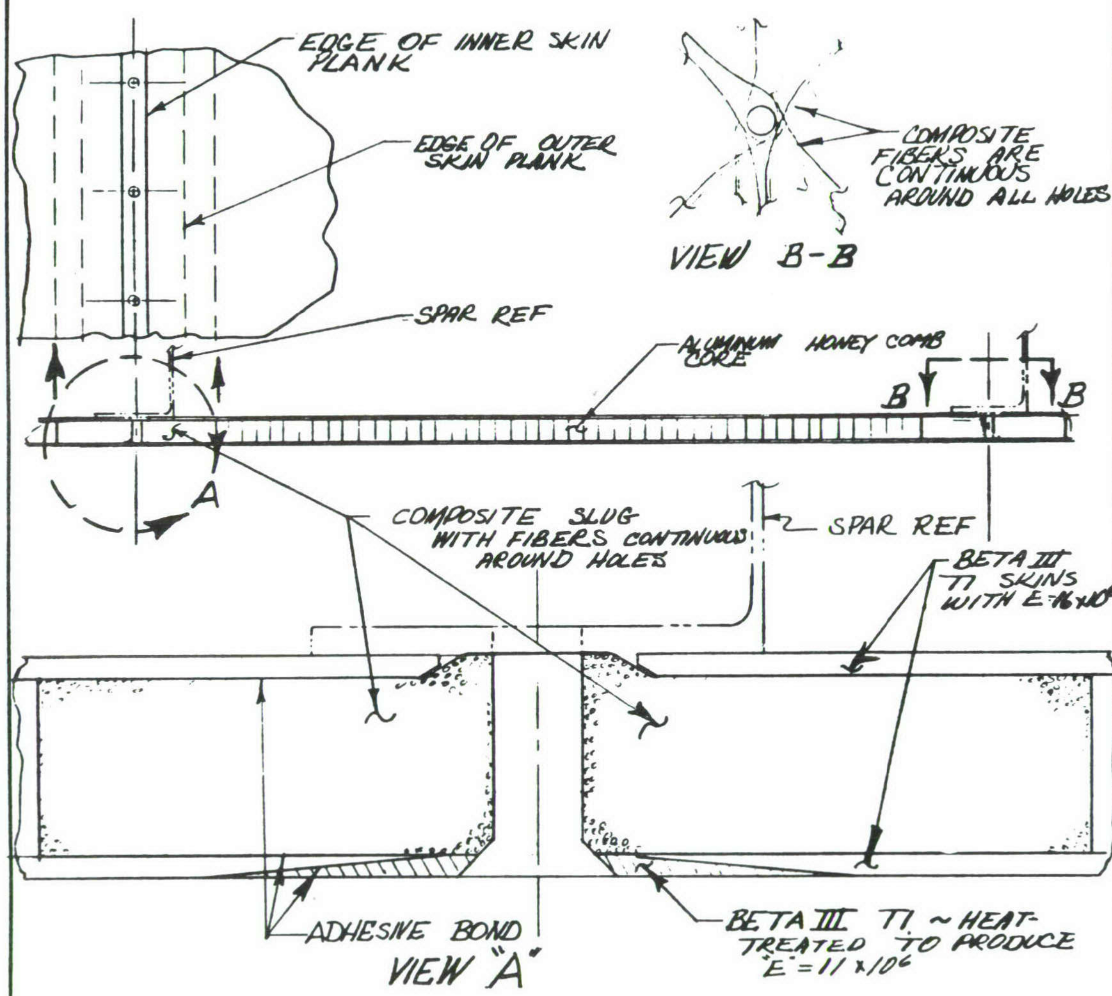
ORIGIN: R. BAYLOR

PREPARED BY [signature] DATE 7-13-72

GENERAL DYNAMICS
Convair Aerospace Division
Fort Worth Operation

STRUCTURAL CONCEPT

610 – 125



TITLE SKIN ~ ADHESIVE BONDED TI SANDWICH WITH COMPOSITE SLUGS HAVING FIBER CONTINUITY AROUND HOLES

CONCEPT DESCRIPTION A SANDWICH SKIN CONCEPT THAT PROVIDES LOW K_t AND GOOD DAMAGE TOLERANCE AT SKIN TO SPAR ATTACH HOLE BY ATTACHING TO COMPOSITE SLUG WITH FIBER CONTINUITY AROUND ALL HOLES.

APPLICATION LOWER SKIN PANEL

MATERIALS BETA III TI & GRAPHITE OR BORON COMPOSITE

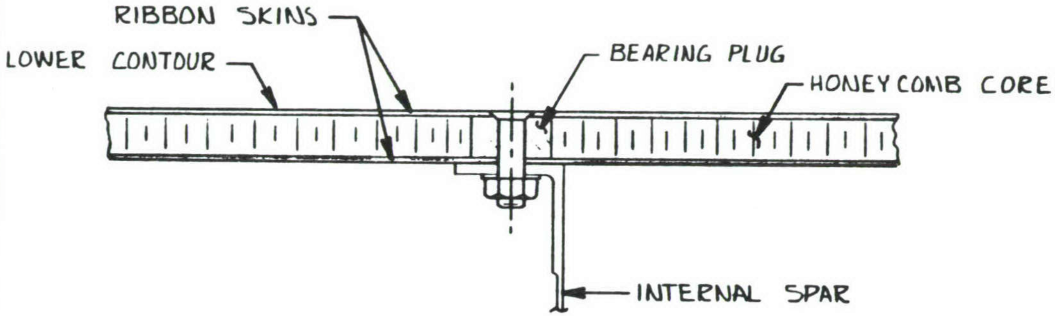
LOAD RANGE 1000 – 20,000#/IN AXIAL LOAD

CONCEPT FEATURES

- CONTINUOUS FIBERS AROUND HOLES IN COMPOSITE SLUG WILL RESULT IN LOW K_t AT HOLES
- TITANIUM FACE SHEETS ARE PLANKED SO THAT FASTENERS DO NOT PENETRATE FACE SHEETS
- RETAINER STRIP AT OUTSIDE CONTOUR IS OF BETA III WITH LOW E SUCH THAT STRESS LEVEL IS REDUCED.

PREPARED BY [signature] DATE 7-14-72

GENERAL DYNAMICS
Convair Aerospace Division
Fort Worth Operation



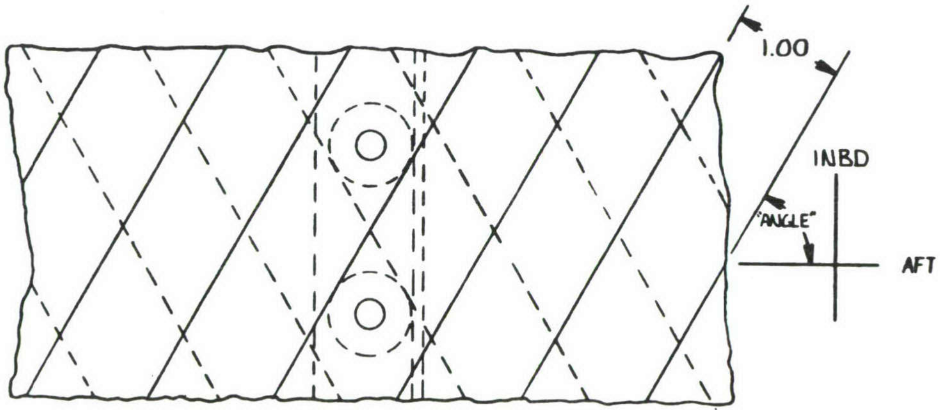


TABLE ~ CANDIDATE MATERIALS

MAT'L.	STRENGTH	DENSITY	SPECIFIC STRENGTH	REMARKS
ALUMINUM	78,000	0.10	780,000	
HIGH STRENGTH STEEL	220,000	0.29	760,000	
6-6-2 TITANIUM	180,000	0.164	1,100,000	
17-7 OR PH 15-7 STEEL	300,000	0.29	1,030,000	BEST CANDIDATE

STRUCTURAL CONCEPT 610-126

TITLE SKIN PANEL, RIBBON SKINS, ADHESIVE BONDED

CONCEPT DESCRIPTION ~ PLIES OF 1.00 INCH WIDE FOIL ARE STACKED ALTERNATELY TO FORM RIBBON SKIN. TWO RIBBON SKINS ARE ADHESIVE BONDED WITH CORE TO FORM PANEL. BEARING PLUGS PROVIDE BEARING AREA FOR FASTENERS.

APPLICATION
TENSION SKIN

MATERIALS SEE TABLE

LOAD RANGE

CONCEPT FEATURES

ADVANTAGES ~

1. FAIL SAFE DESIGN
2. MINIMUM MACHINING
3. MINIMUM MATERIAL WASTE
4. REPAIRABLE
5. NO STRAIGHTENING REQUIRED
6. CORE PROVIDES STABILITY
7. STIFFNESS AND STRENGTH CAN BE TAILORED BY VARYING "ANGLE".

DISADVANTAGES ~

1. HIGH ADHESIVE WEIGHT

PREPARED BY (N CARTER) J. D. Bixler **DATE** 7/18/72

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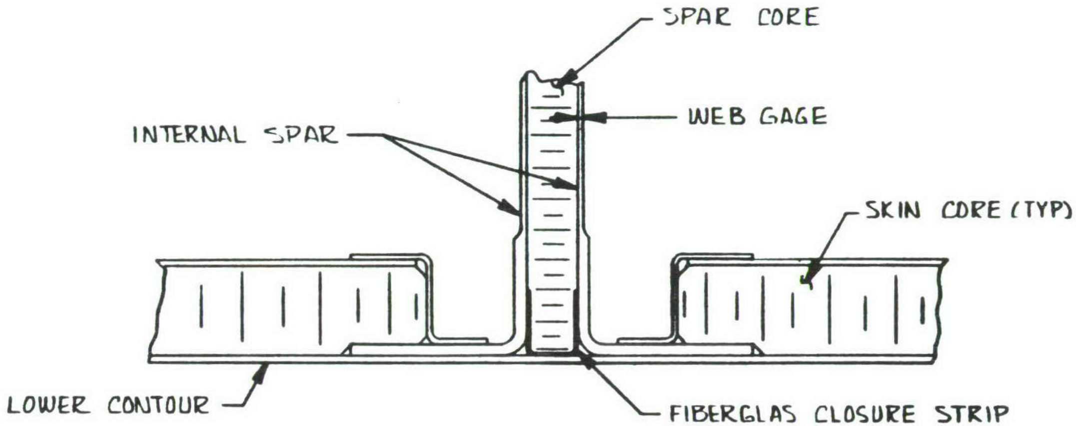
Fort Worth Operation



FABRICATION SEQUENCE ~

1. SIZE TAPERED SPAR SHEET
2. CHEM ETCH SHEET TO WEB GAGE
3. FORM SPAR CAPS
4. ADHESIVE BOND SPARS TO SPAR WEB CORE
5. ADHESIVE BOND SKIN CORE AND SPARS TO SKIN

STRUCTURAL CONCEPT 610-127

TITLE STIFFENED INTEGRATED SPAR WEB / LOWER PANEL SANDWICH

CONCEPT DESCRIPTION 2-PIECE SPAR BONDED TO CORE. THEN BONDED INTO SANDWICH LOWER SKIN.

APPLICATION
JOINT CONCEPT

MATERIALS
BETA III OR 8-8-2-3 TITANIUM

LOAD RANGE

CONCEPT FEATURES

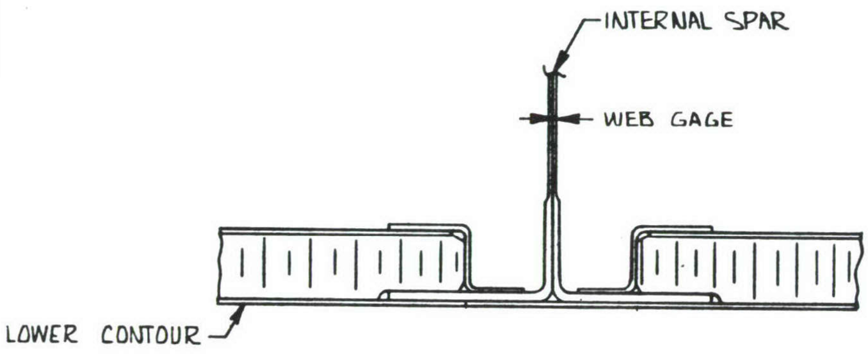
ADVANTAGES ~
1. SAME AS DWG NO. 610-128
2. STABILIZES SPAR WEB.

DISADVANTAGES ~
1. IMPACT ON FUEL VOLUME

PREPARED BY J D Bixler

DATE 7/12/72

GENERAL DYNAMICS
Convair Aerospace Division
Fort Worth Operation



FABRICATION SEQUENCE ~

1. SIZE TAPERED SPAR SHEET
2. CHEM ETCH SHEET TO WEB GAGE
3. FORM SPAR CAPS
4. ADHESIVE BOND SPARS BACK-TO-BACK
5. ADHESIVE BOND HONEYCOMB CORE AND SPARS TO SKIN

STRUCTURAL CONCEPT 610-128

TITLE INTEGRATED SPAR WEB / LOWER PANEL SANDWICH

CONCEPT DESCRIPTION ~ 2-PIECE SPAR BONDED TOGETH-ER, THEN BONDED INTO SANDWICH LOWER SKIN.

APPLICATION
JOINT CONCEPT

MATERIALS
BETA III or 8-8-2-3 TITANIUM

LOAD RANGE

CONCEPT FEATURES

ADVANTAGES ~

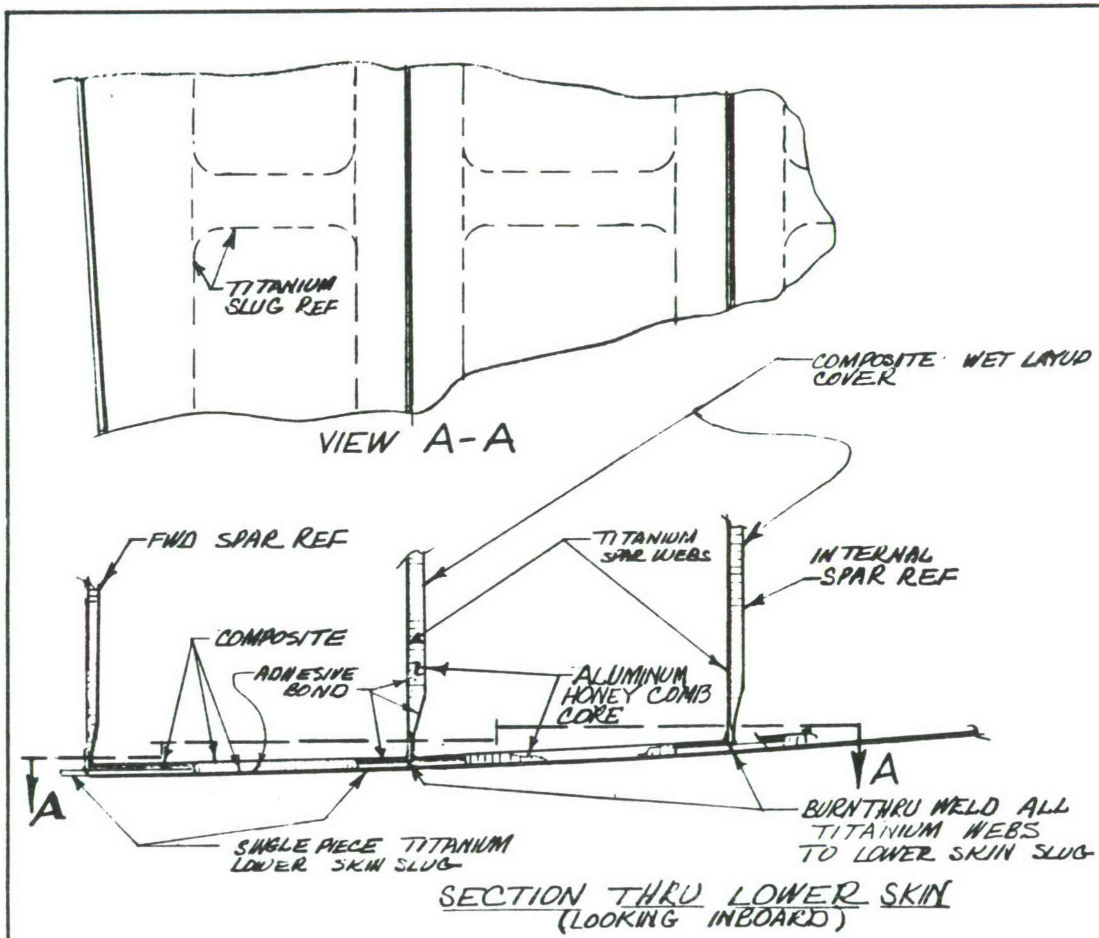
1. MINIMIZES WEIGHT
2. MAXIMIZES DAMAGE TOLERANCE
3. MINIMIZES HOLES IN LOWER SURFACES.
4. OVERLAP OF CORE ON SPAR CAP PROVIDES POSITIVE INNER SKIN / SPAR WEB SHEAR TIE

DISADVANTAGES ~

1. STABILIZING THIN SPAR WEB.

PREPARED BY (R.N. BAYLOR) J D Bixler   DATE 7/11/72

GENERAL DYNAMICS
Convair Aerospace Division
Fort Worth Operation



SECTION THRU LOWER SKIN
(LOOKING INBOARD)

STRUCTURAL CONCEPT	610-129

TITLE SKIN ~ LOWER, ONE PIECE SLUG WELDED TO SPAR WEBS WITH COMPOSITE SANDWICH OVERLAY

CONCEPT DESCRIPTION LOWER SKIN/INTERNAL SPAR CONCEPT HAVING ONE PIECE SLUG WELDED TO SPAR WEBS WITH COMPOSITE HONEYCOMB SANDWICH BONDED OVER WELDED SUBSTRUCTURE

APPLICATION LOWER SKIN SPAR COMBINATION

MATERIALS TITANIUM OR STEEL SUBSTRACT. & GRAPHITE OR BORON COMPOSITE

LOAD RANGE 500 TO 25,000#/IN AXIAL LOAD

CONCEPT FEATURES
- STRUCTURALLY EFFICIENT
- GOOD DAMAGE TOLERANCE CHARACTERISTICS
- POSITIVE TIE BETWEEN SPARS & LOWER SKIN WITHOUT USE OF MECHANICAL FASTENERS

PREPARED BY [signature] DATE 7-20-72

GENERAL DYNAMICS
Convair Aerospace Division
Fort Worth Operation

STRUCTURAL CONCEPT 610-130

TITLE WING SKIN PANEL – BI-METAL SANDWICH

CONCEPT DESCRIPTION
STEEL SKINS BRAZED OR BONDED TO TI CORE AND SLUG TO PRODUCE RESIDUAL COMPRESSION STRESS IN TI SLUG

APPLICATION
WING TENSION SKIN

MATERIALS STEEL (301, ½H), TI (6-4, β)

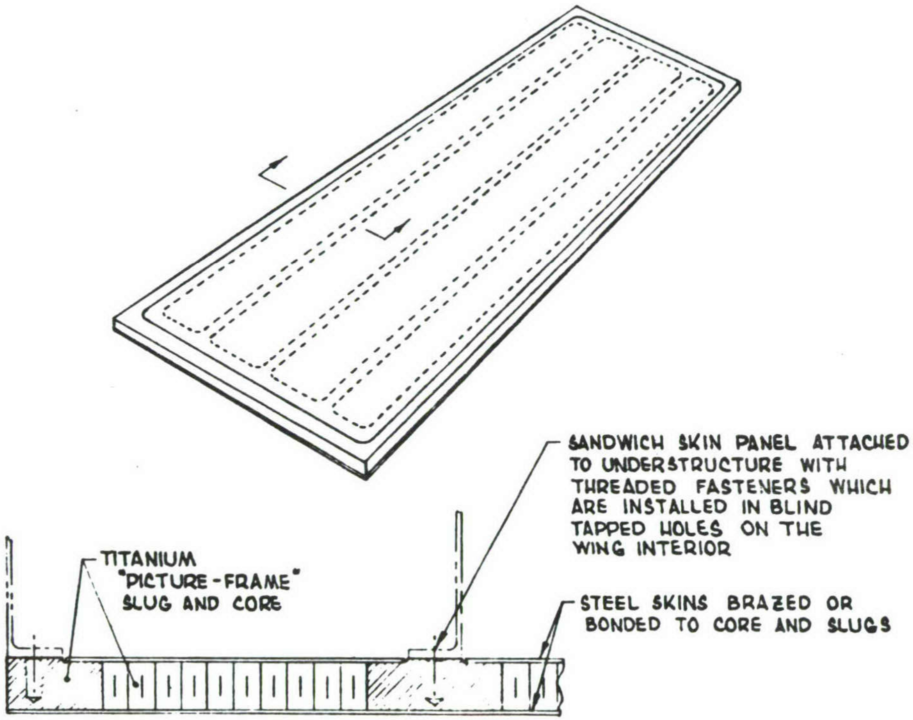
LOAD RANGE

CONCEPT FEATURES

- LOW TEMPERATURE BRAZING OR BONDING PRODUCES A SANDWICH SKIN PANEL WHEREIN THE STEEL SKINS ARE IN TENSION (~20 KSI) AND THE TI SLUG IS IN COMPRESSION (~40 KSI) IN THE AXIAL DIRECTION, THEREBY OFFERING IMPROVED FATIGUE RESISTANCE IN A TENSION-LOADED WING LOWER SKIN.
- NO FASTENERS PENETRATE THE SKIN; IMPROVED FATIGUE LIFE.

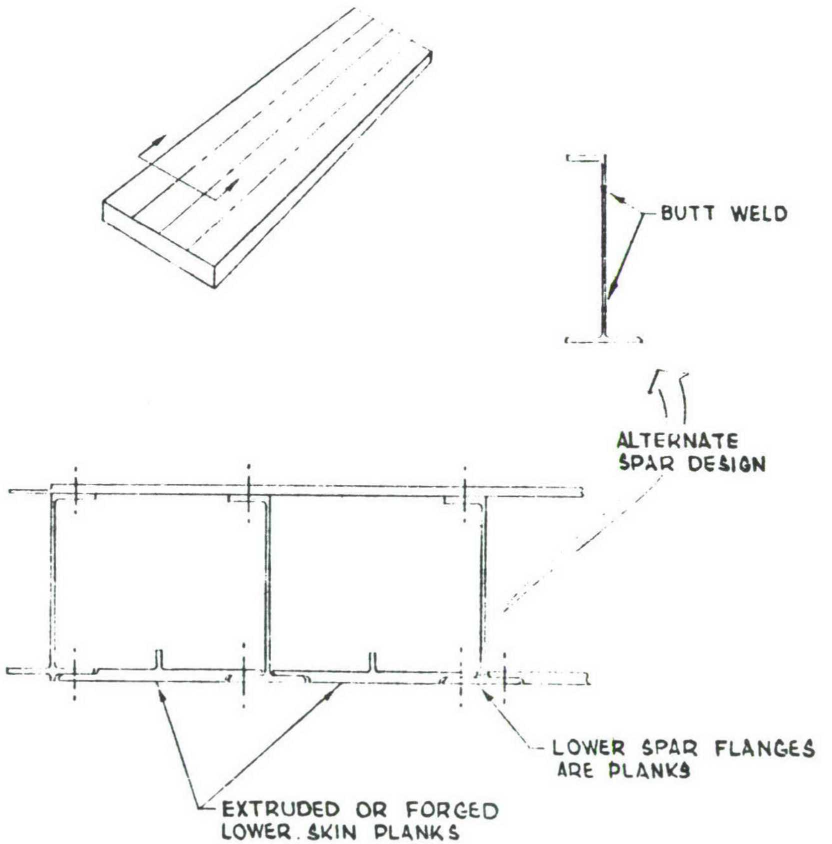
PREPARED BY D. E. Bloom **DATE** 7.25.72

GENERAL DYNAMICS
Convair Aerospace Division
Fort Worth Operation



MANUFACTURING SEQUENCE

1. LAY UP STEEL SHEETS AND TI CORE AND SLUG WITH BRAZE ALLOY FOIL OR TAPE ADHESIVE BETWEEN THEM.
2. APPLY UNIFORM PRESSURE TO THE ASSEMBLY TO HOLD THE PARTS IN INTIMATE CONTACT WITH ONE ANOTHER.
3. RAISE THE TEMPERATURE TO A SUITABLE LEVEL FOR THE BRAZE ALLOY OR THE ADHESIVE AND STABILIZE.
4. COOL TO AMBIENT TEMPERATURE BEFORE RELEASING PRESSURE.



STRUCTURAL CONCEPT 610-131

TITLE
WING SKIN PANEL - PLANKED

CONCEPT DESCRIPTION
LOWER SKIN CONSISTS OF INTEGRALLY STIFFENED LAPPED PLANKS. SPAR FLANGES SERVE AS PLANKS

APPLICATION
WING TENSION SKIN

MATERIALS ALUMINUM, TITANIUM

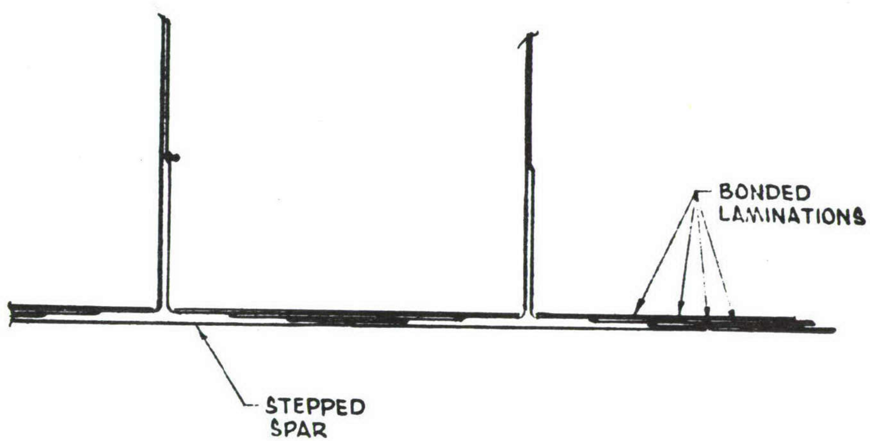
LOAD RANGE

CONCEPT FEATURES

- PLANKED LOWER COVER IS FAIL-SAFE
- EXTERNAL PLACEMENT OF LOWER SPAR FLANGES (WHICH ARE ALSO PLANKS) PROVIDES MAXIMUM INSPECTABILITY

PREPARED BY J. E. Bloom DATE 7-28-72

GENERAL DYNAMICS
Convair Aerospace Division
Fort Worth Operation



STRUCTURAL CONCEPT 610-132

TITLE
WING SKIN PANEL - LAMINATED

CONCEPT DESCRIPTION
LOWER SKIN CONSISTS OF MANY THIN SHEETS BONDED TOGETHER AND TO STEPPED SPAR FLANGES

APPLICATION WING TENSION SKIN (PARTICULARLY NEAR TIP)

MATERIALS ALUMINUM, TITANIUM

LOAD RANGE

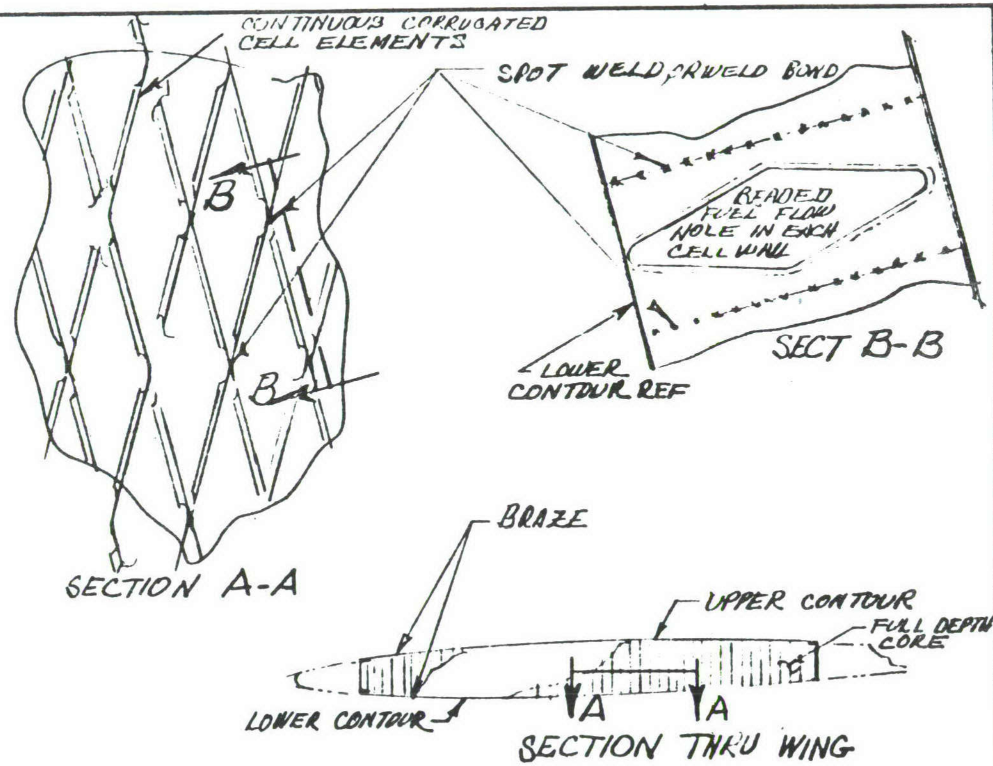
CONCEPT FEATURES

- ADJUSTMENT OF SPAR SPACING AND SKIN PANEL TOTAL THICKNESS WILL YIELD MINIMUM WEIGHT DESIGN
- EXTERNAL PLACEMENT OF LOWER SPAR FLANGES (WHICH ARE PLANKS) PROVIDES MAXIMUM INSPECTABILITY
- LAMINATED CONSTRUCTION IS FAIL-SAFE
- DESIGN ACCOMMODATES SPANWISE TAPER IN SPAR SPACING AND IN SKIN THICKNESS

CONCEIVED BY: E.W. GOMEZ

PREPARED BY [signature] **DATE** 7-28-72

GENERAL DYNAMICS
Convair Aerospace Division
Fort Worth Operation



STRUCTURAL CONCEPT 610-133

TITLE SKIN ~ SANDWICH/FULL DEPTH CORE WITH BEADED FLOW HOLES

CONCEPT DESCRIPTION
FUELED WING CONCEPT WITH FULL DEPTH CORE BETWEEN UPPER & LOWER CONTOUR WITH BEADED FUEL FLOW HOLES.

APPLICATION FUELED WING STRUCTURE WITH HIGH INTERNAL TANK PRESS.

MATERIALS TITANIUM OR STEEL

LOAD RANGE 800 TO 20,000 #/IN AXIAL LOAD PLUS 100 PSI INTERNAL ...

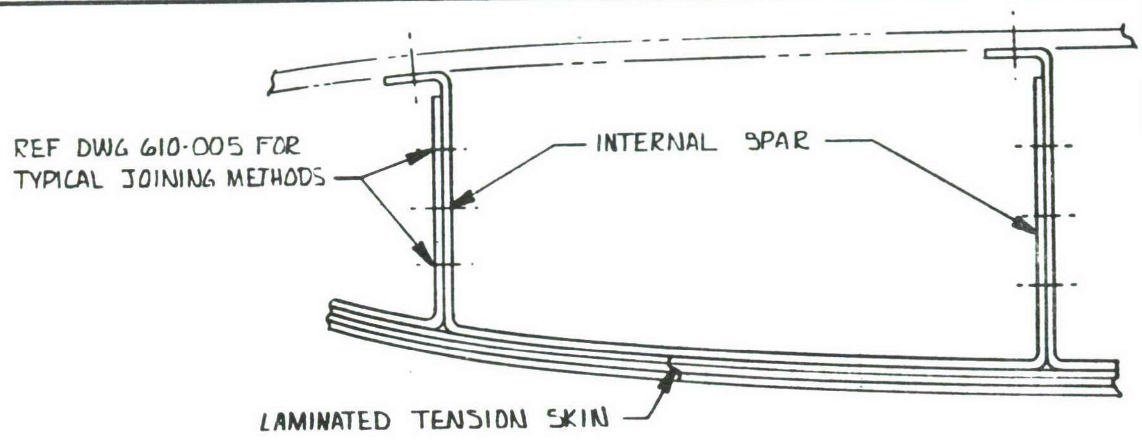
CONCEPT FEATURES
- A MINIMUM WEIGHT CONCEPT WHERE HIGH INTERNAL TANK PRESSURES & HIGH WING BENDING LOADS EXIST.

PREPARED BY [signature] DATE 7-27-7[illegible]

GENERAL DYNAMICS
Convair Aerospace Division
Fort Worth Operation

INTERNAL SPAR CONCEPTS

SKETCHES 610-200 THROUGH 610-221



STRUCTURAL CONCEPT	610-200
TITLE INTERNAL SPAR, ONE PIECE FORMED PAN	
CONCEPT DESCRIPTION SHEET IS FORMED INTO A TROUGH SHAPE AND BONDED, RIVETED, OR BRAZED TO A LAMINATED SKIN.	
APPLICATION SPAR/TENSION SKIN COMBINATION	
MATERIALS ALUMINUM OR TITANIUM	
LOAD RANGE	

CONCEPT FEATURES

ADVANTAGES ~

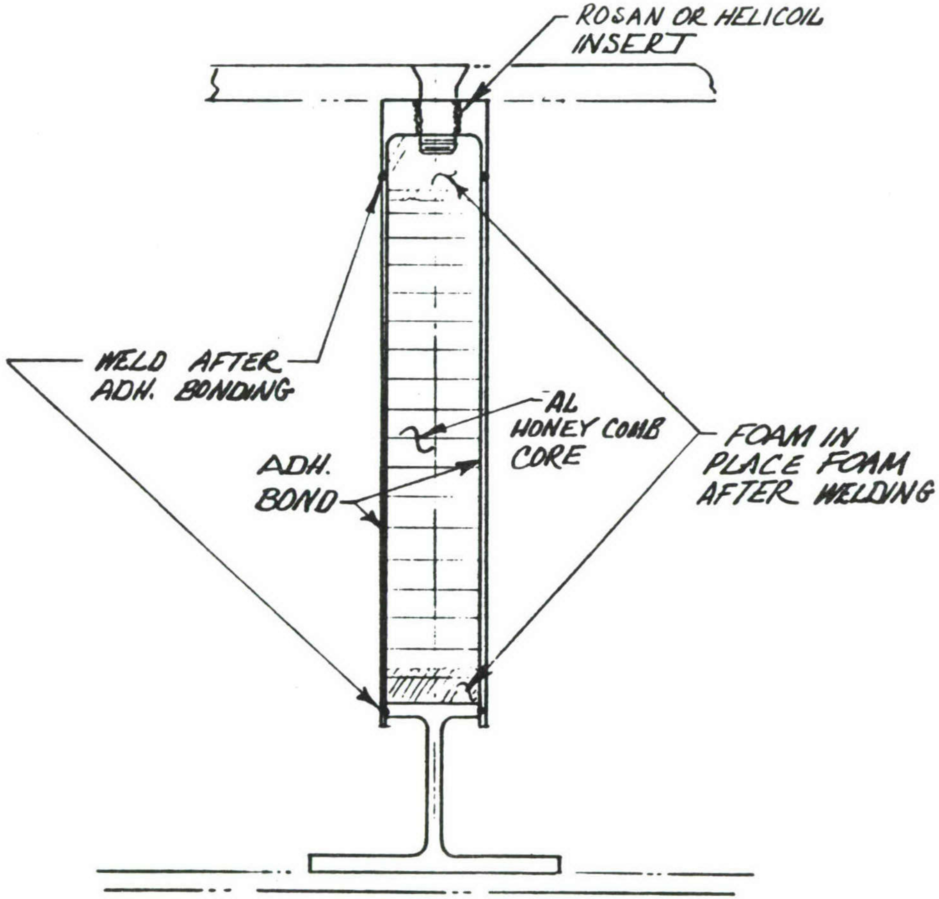
1. FAIL SAFE DESIGN
2. SPARS CAN BE SIZED TO CARRY BENDING AND SKINS TO CARRY TORSION AND CHORD BENDING
3. EASY TO MODIFY DESIGN.

DISADVANTAGES ~

1. MATING SPARS COULD BE DIFFICULT.
2. SKIN STEPS DIFFICULT TO FORM INTO SPARS

PREPARED BY J D Bixler | DATE 6/15/72

GENERAL DYNAMICS
Convair Aerospace Division
Fort Worth Operation



STRUCTURAL CONCEPT 610-201

TITLE SPAR - INTERMEDIATE, BONDED SANDWICH WEB WITH WELD ON CAPS

CONCEPT DESCRIPTION SHEAR RESISTANT ADH. BONDED SANDWICH INTERMEDIATE SPAR WITH CAPS WELDED ON AFTER BONDING - NO FASTENERS THRU LOWER TEN. CAP.

APPLICATION INTERMEDIATE WING SPAR

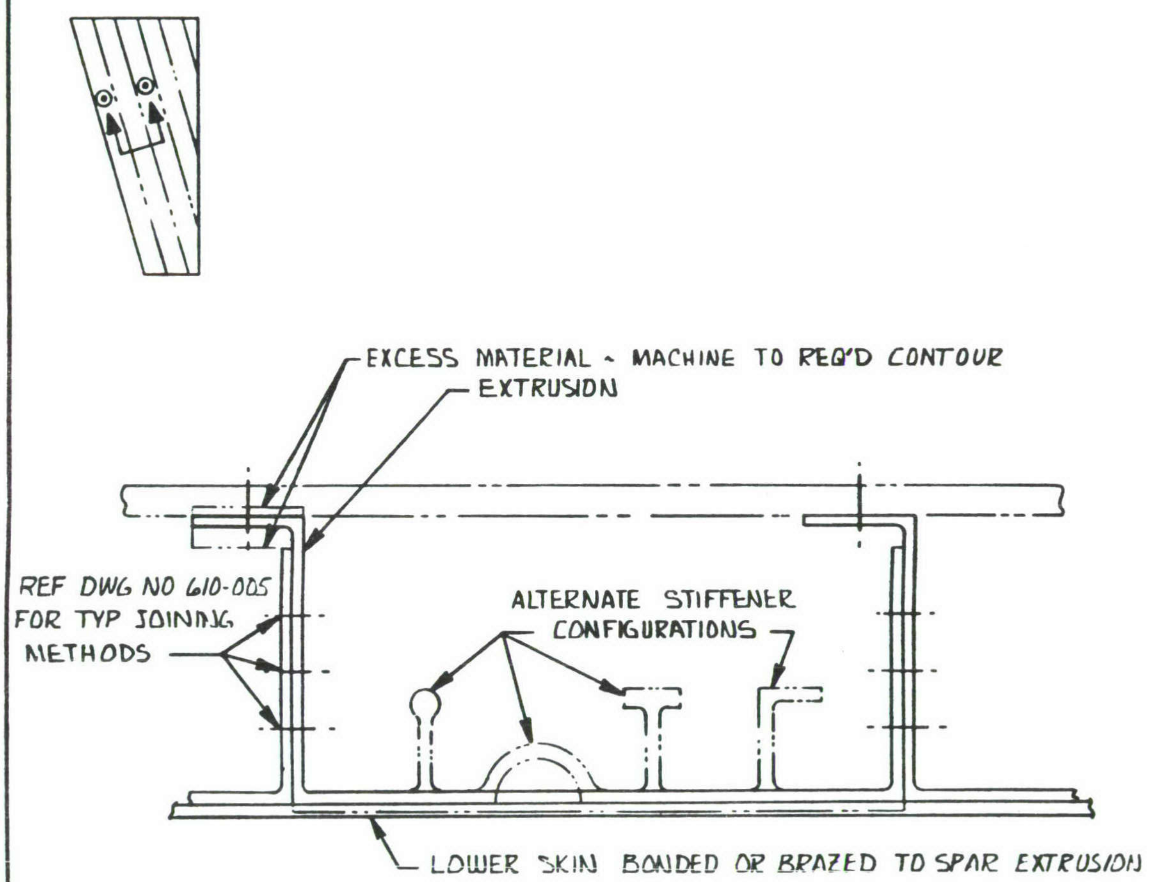
MATERIALS TITANIUM OR STEEL

LOAD RANGE 1000 TO 40,000 # AXIAL LOAD IN CAPS - 100 - 20000 #/IN SHEAR FLOW IN WEB

CONCEPT FEATURES
- CAPS EFFICIENTLY CARRY AXIAL LOAD
- WEBS STABLE IN SHEAR UP TO ULT LOAD
- NO FASTENERS THRU LOWER TEN. LOADED CAP

PREPARED BY [signature] DATE 5-19-72

GENERAL DYNAMICS
Convair Aerospace Division
Fort Worth Operation



SECTION ⊙-⊙
(ROTATED ≈ 16° CW)

STRUCTURAL CONCEPT 610-202

TITLE INTERNAL SPAR, EXTRUDED PAN

CONCEPT DESCRIPTION MAT'L IS EXTRUDED INTO TROUGH SHAPE, FORMED TO REQ'D TWIST, MACHINED TO REQ'D DEPTH, AND BONDED TO LOWER SKIN.

APPLICATION
INTERNAL SPAR

MATERIALS
ALUMINUM OR TITANIUM

LOAD RANGE

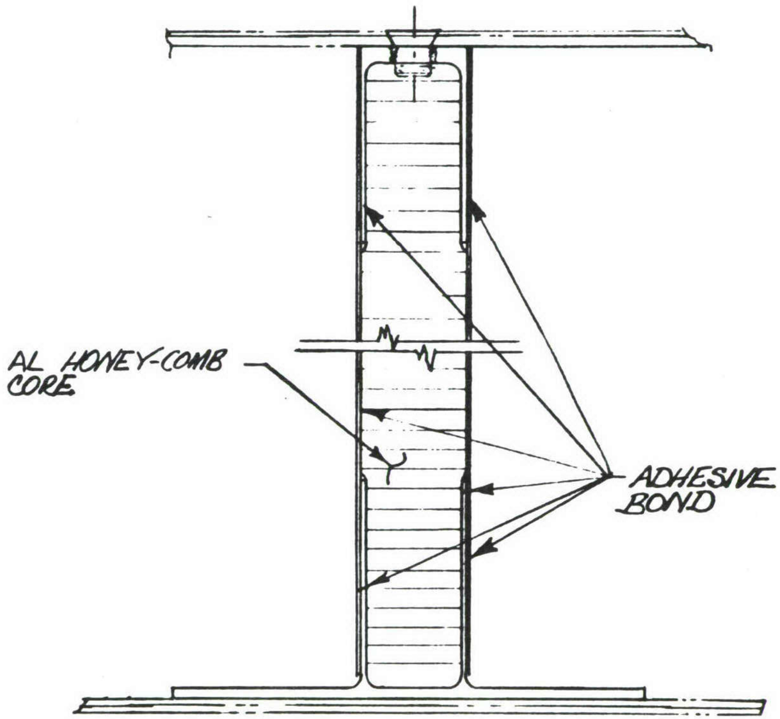
CONCEPT FEATURES

ADVANTAGES~
1. FAIL SAFE DESIGN
2. MANY STIFFENER CONFIGURATIONS POSSIBLE

DISADVANTAGES~
1. MACHINING TO CONTOUR EXPENSIVE.

PREPARED BY J. D. Ripley DATE 6/19/72

GENERAL DYNAMICS
Convair Aerospace Division
Fort Worth Operation



SECTION THRU SPAR

STRUCTURAL CONCEPT 610-203

TITLE SPAR ~ INTERNAL, ADHESIVE BONDED SANDWICH WITH INTEGRAL CAPS

CONCEPT DESCRIPTION CAPS ADHESIVE BONDED TO HONEY COMB SANDWICH PANEL

APPLICATION INTERNAL SPAR

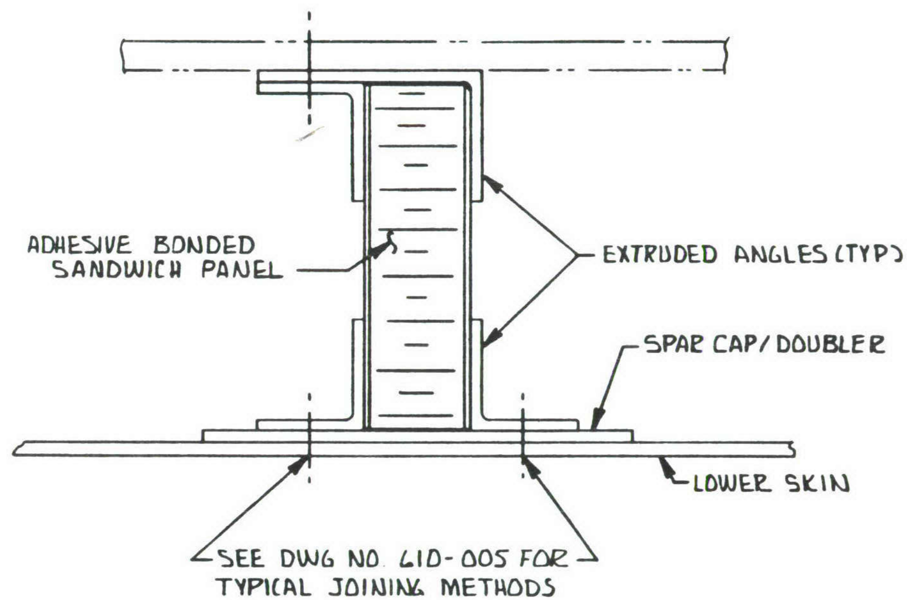
MATERIALS AL OR TITANIUM

LOAD RANGE 100 TO 8000#/IN SHEAR FLOW

CONCEPT FEATURES
- EFFICIENT SHEAR RESISTANT SPAR SHEAR WEB

PREPARED BY R.W. McInally DATE 6-19-72

GENERAL DYNAMICS
Convair Aerospace Division
Fort Worth Operation



STRUCTURAL CONCEPT 6ID-204

TITLE INTERNAL SPAR, SANDWICH, EXTRUDED ANGLES

CONCEPT DESCRIPTION SHEAR LOADS CARRIED BY ADHESIVE BONDED SANDWICH PANEL. BENDING LOADS CARRIED BY EXTRUDED ANGLES BONDED TO SANDWICH PANEL.

APPLICATION
INTERNAL SPAR

MATERIALS
ALUMINUM OR TITANIUM

LOAD RANGE

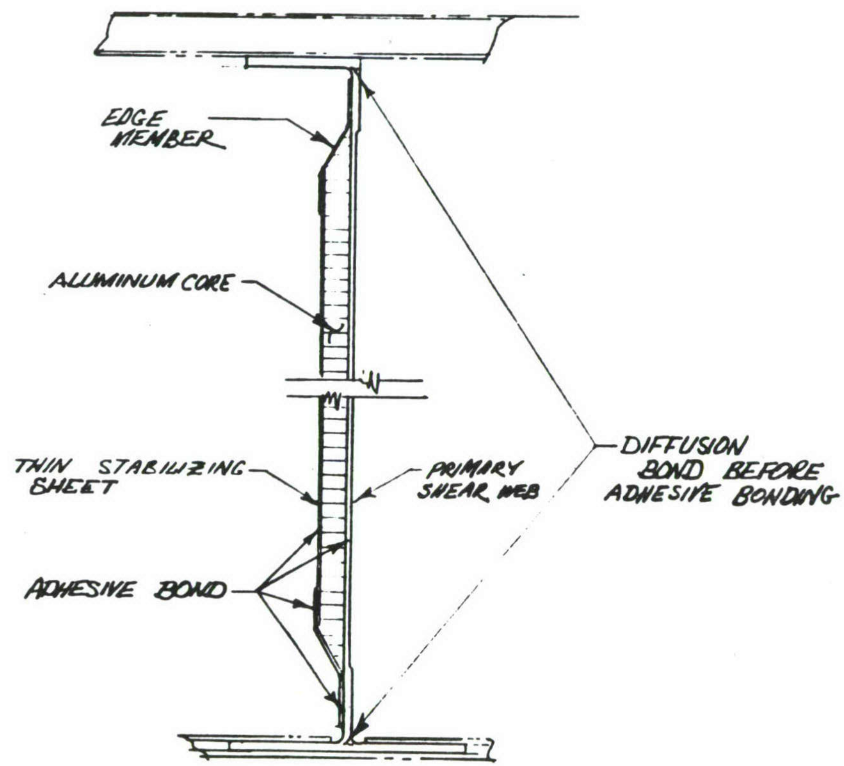
CONCEPT FEATURES

ADVANTAGES ~
1. FAIL SAFE
2. GOOD SHEAR STABILITY

DISADVANTAGES ~
1. IMPACT ON FUEL VOLUME

PREPARED BY J. D. Bixler DATE 6/19/72

GENERAL DYNAMICS
Convair Aerospace Division
Fort Worth Operation



STRUCTURAL CONCEPT

610 – 205

TITLE SPAR ~ INTERNAL, DIFFUSION BONDED CAPS, HONEYCOMB SANDWICH STABILIZED WEB

CONCEPT DESCRIPTION CONCEPT CONSISTS OF A PRIMARY SHEAR WEB JOINED TO SPAR CAPS BY DIFFUSION BONDING WITH THE PRIMARY SHEAR WEB STABILIZED BY ADH. BONDED HONEYCOMB CORE & THIN FACE SHEET

APPLICATION INTERNAL SPAR

MATERIALS TITANIUM

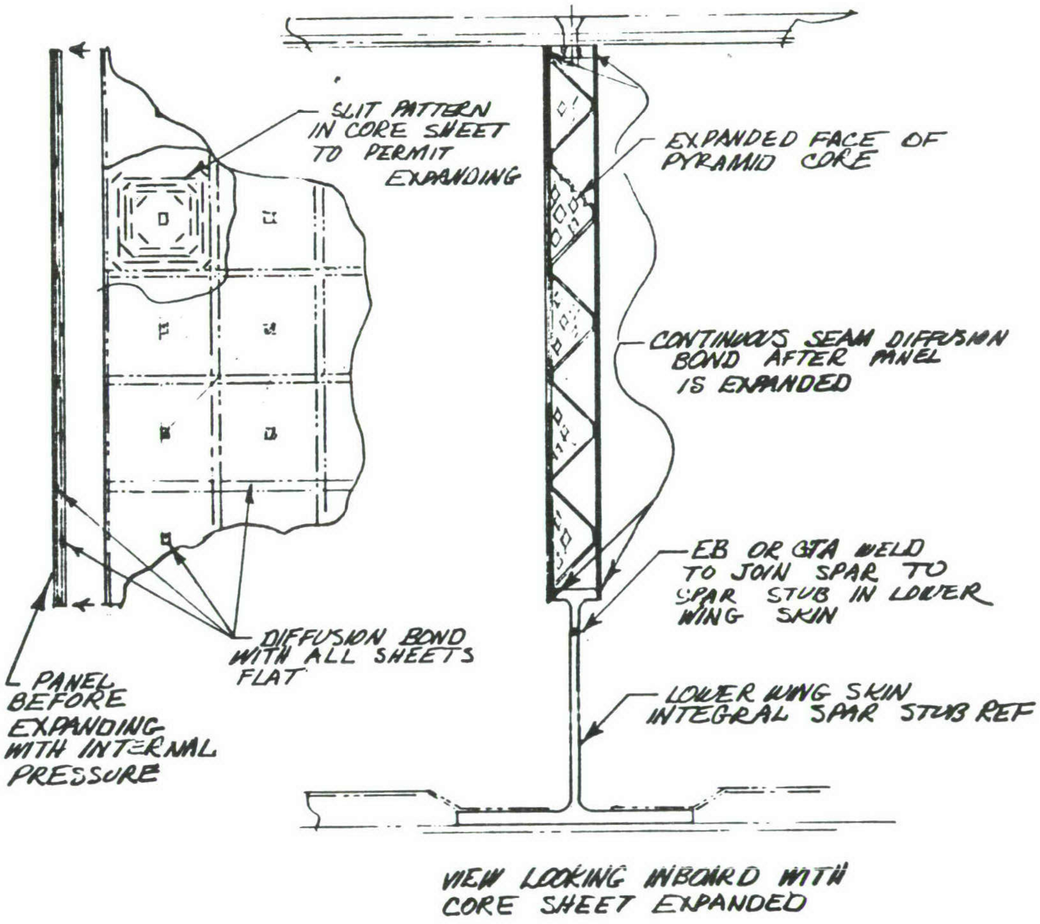
LOAD RANGE 100 – 20000 #/IN SHEAR

CONCEPT FEATURES

- SHEAR WEB STABILIZED TO ULT STRENGTH OF SHEAR WEB MATL.

PREPARED BY D W McAnally DATE 6-19-72

GENERAL DYNAMICS
Convair Aerospace Division
Fort Worth Operation



STRUCTURAL CONCEPT 610-206

TITLE SPAR – INTERNAL, DIFFUSION BONDED EXPANDED PYRAMID CORE

CONCEPT DESCRIPTION SPAR WEB CONCEPT THAT CONSISTS OF TWO FACE SHEETS DIFFUSION BONDED IN A SPECFIED PATTERN TO A SLITTED CORE SHEET THEN EXPAND TO FORM A SHEAR RESISTANT PANEL

APPLICATION INTERNAL SPARS

MATERIALS TITANIUM ALLOY

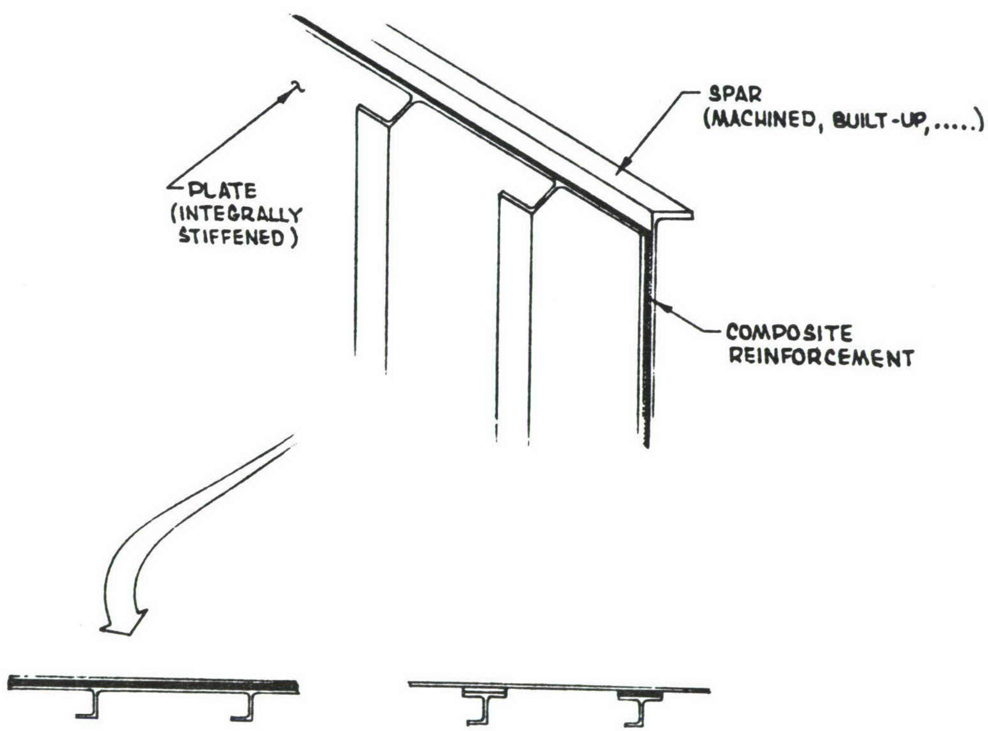
LOAD RANGE 100 – 10,000 #/IN SHEAR

CONCEPT FEATURES
- HIGH TEMP RESISTANCE
- READILY INSTALLED BY WELDING TO OTHER WING STRUCTURE

PREPARED BY R W McAnelly DATE 6-20-72

GENERAL DYNAMICS
Convair Aerospace Division
Fort Worth Operation

ADHESIVE BONDED ASSEMBLY



STRUCTURAL CONCEPT 610 - 207

TITLE
SPAR - INTERMEDIATE,
COMPOSITE REINFORCED

CONCEPT DESCRIPTION
BASIC SPAR IS REINFORCED BY A LAYER OF COMPOSITE MATERIAL INSTALLED UNDER SEPARATE STIFFENING ELEMENT

APPLICATION WING SPARS

MATERIALS TITANIUM, ALUMINUM

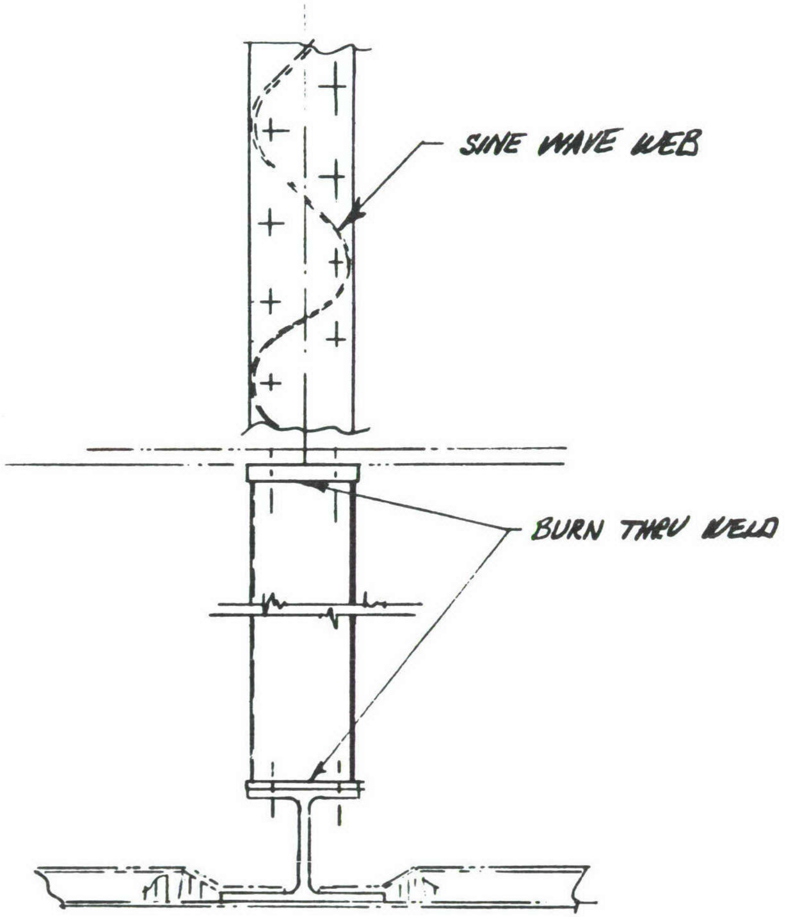
LOAD RANGE

CONCEPT FEATURES

- WEIGHT SAVING
- APPLICABLE, IN VARIOUS ARRANGEMENTS, TO CLOSURE SPARS, RIBS, BULKHEADS, AND SKIN PANELS

PREPARED BY [signature] DATE 6·21·72

GENERAL DYNAMICS
Convair Aerospace Division
Fort Worth Operation



STRUCTURAL CONCEPT 610-208

TITLE SPAR- SINE WAVE, WELD-ON CAPS

CONCEPT DESCRIPTION SINE WAVE WEB BURN THRU WELDED TO UPPER & LOWER CAPS

APPLICATION SPAR OR BHD SHEAR WEBS

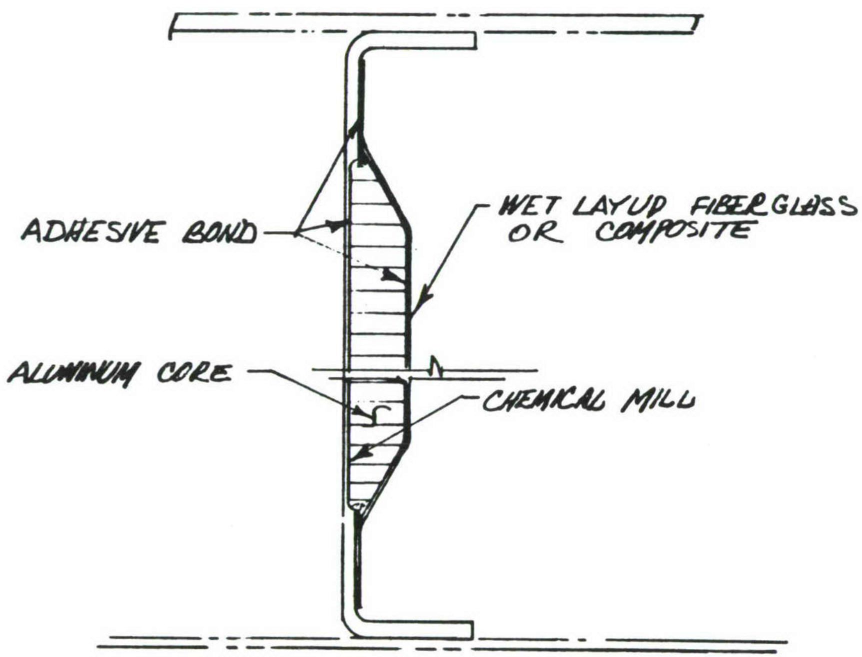
MATERIALS TITANIUM, ALUMINUM OR STEEL

LOAD RANGE FLOW 100 - 10,000 #/IN SHEAR

CONCEPT FEATURES
- LOW COST

PREPARED BY R.W. McCready DATE 6-21-72

GENERAL DYNAMICS
Convair Aerospace Division
Fort Worth Operation



STRUCTURAL CONCEPT 610-209

TITLE SPAR ~ INTERNAL, FORMED CHANNEL WITH WET LAYUP FIBERGLASS SANDWICH STABILIZATION

CONCEPT DESCRIPTION FORMED CHANNEL WITH SHEAR WEB STABILIZED WITH HONEY COMB CORE & WET LAYUP FIBER GLASS OR COMPOSITE FACE

APPLICATION INTERNAL SPAR OR BHD.

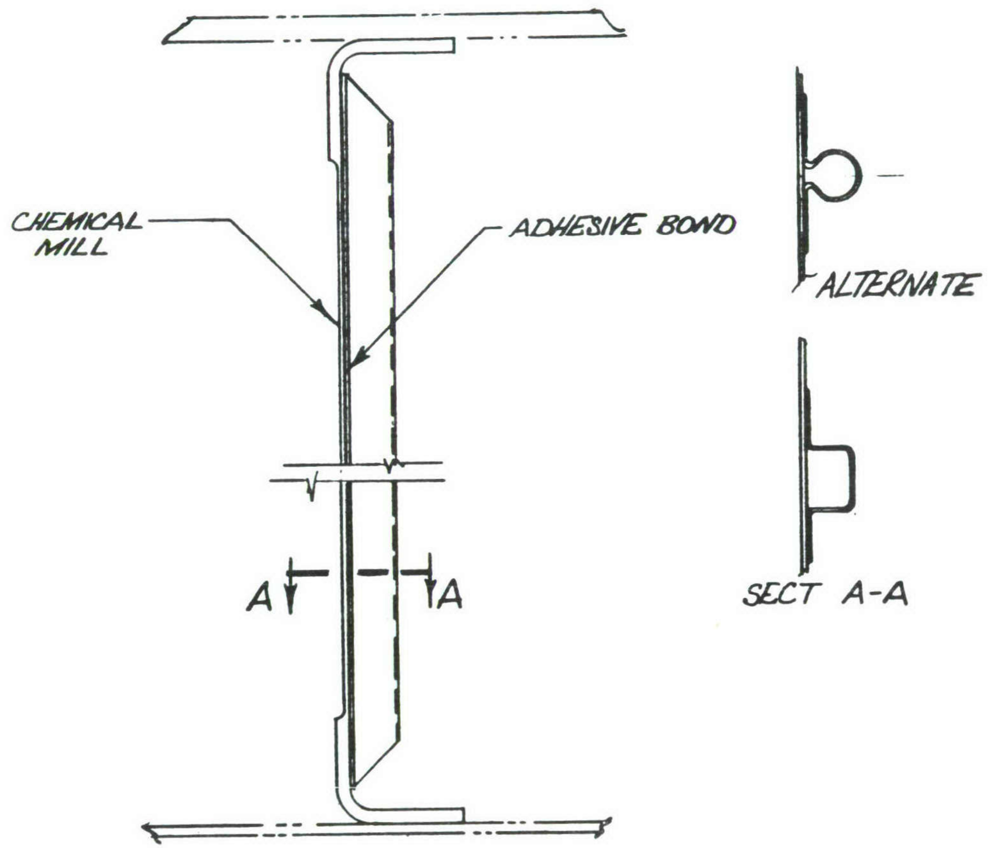
MATERIALS AL OR TI WITH FIBERGLASS OR COMPOSITE

LOAD RANGE 100 – 10,000 #/IN SHEAR FLOW

CONCEPT FEATURES
- LOW COST SHEAR WEB
- NO COMPLEX TOOLING REQD.
- EFFICIENT

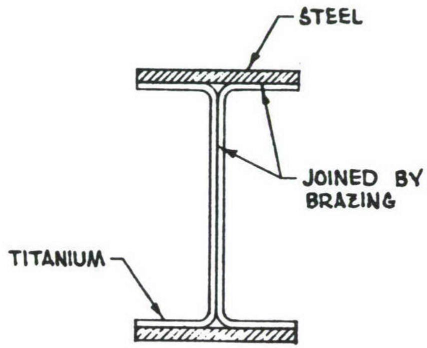
PREPARED BY [signature] DATE 6-21-72

GENERAL DYNAMICS
Convair Aerospace Division
Fort Worth Operation

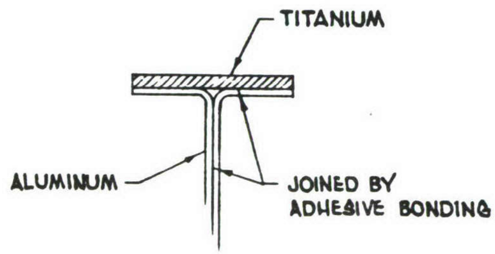


STRUCTURAL CONCEPT	610-210
TITLE SPAR - INTERNAL, FORMED CHANNEL WITH ADH. BONDED STIFFENERS	
CONCEPT DESCRIPTION FORMED SHEET METAL SPAR WITH ADH. BONDED ON STIFFENERS	
APPLICATION INTERNAL SPAR	
MATERIALS TITANIUM OR ALUMINUM	
LOAD RANGE 100 - 10,000 #/IN SHEAR	
CONCEPT FEATURES • ECONOMICAL TO MANUFACTURE	
PREPARED BY R W McCreilly	DATE 6-21-72

GENERAL DYNAMICS
Convair Aerospace Division
Fort Worth Operation



ALTERNATE



STRUCTURAL CONCEPT 610-211

TITLE SPAR - BI-METAL, INTERMEDIATE

CONCEPT DESCRIPTION SPARS OR OTHER STRUCTURAL MEMBERS MADE BY JOINING DIFFERENT METALS

APPLICATION INTERNAL SPARS (OR RIBS) AND CLOSURE SPARS (OR BULKHEADS)

MATERIALS TITANIUM, STEEL, ALUMINUM

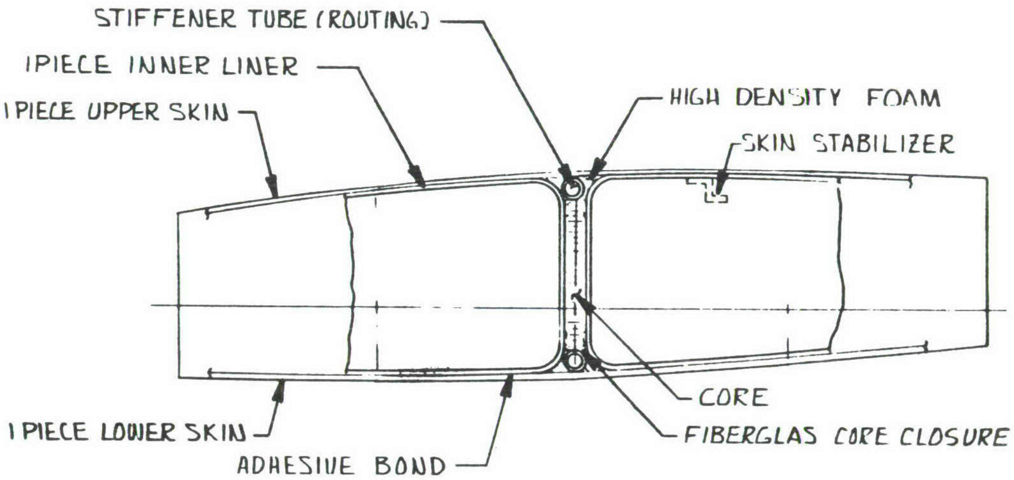
LOAD RANGE

CONCEPT FEATURES

- PERMITS EFFICIENT UTILIZATION OF PROPERTIES OF THE CANDIDATE METALS

PREPARED BY D.E. Boon DATE 6-22-72

GENERAL DYNAMICS
Convair Aerospace Division
Fort Worth Operation



NOTES~

1. INNER LINERS AND STIFFENER TUBES CARRY BENDING LOADS
2. OUTER SKINS CARRY TORSIONAL AND CHORDWISE LOADS
3. SKIN STABILIZERS ADDED AS REQUIRED

STRUCTURAL CONCEPT 610-212

TITLE INTERNAL SPAR, INNER LINER & STIFFNER TUBE COMBINATION

CONCEPT DESCRIPTION CORE IS ADHESIVE BONDED TO 1 PIECE INNER LINERS. STIFFENER TUBE BONDED IN PLACE AND OUTER SKINS BONDED TO COMPLETE STRUCTURE

APPLICATION
INTERNAL SPARS

MATERIALS ALUMINUM OR TITANIUM
ADV. COMPOSITE FOR STIFFENER TUBES

LOAD RANGE

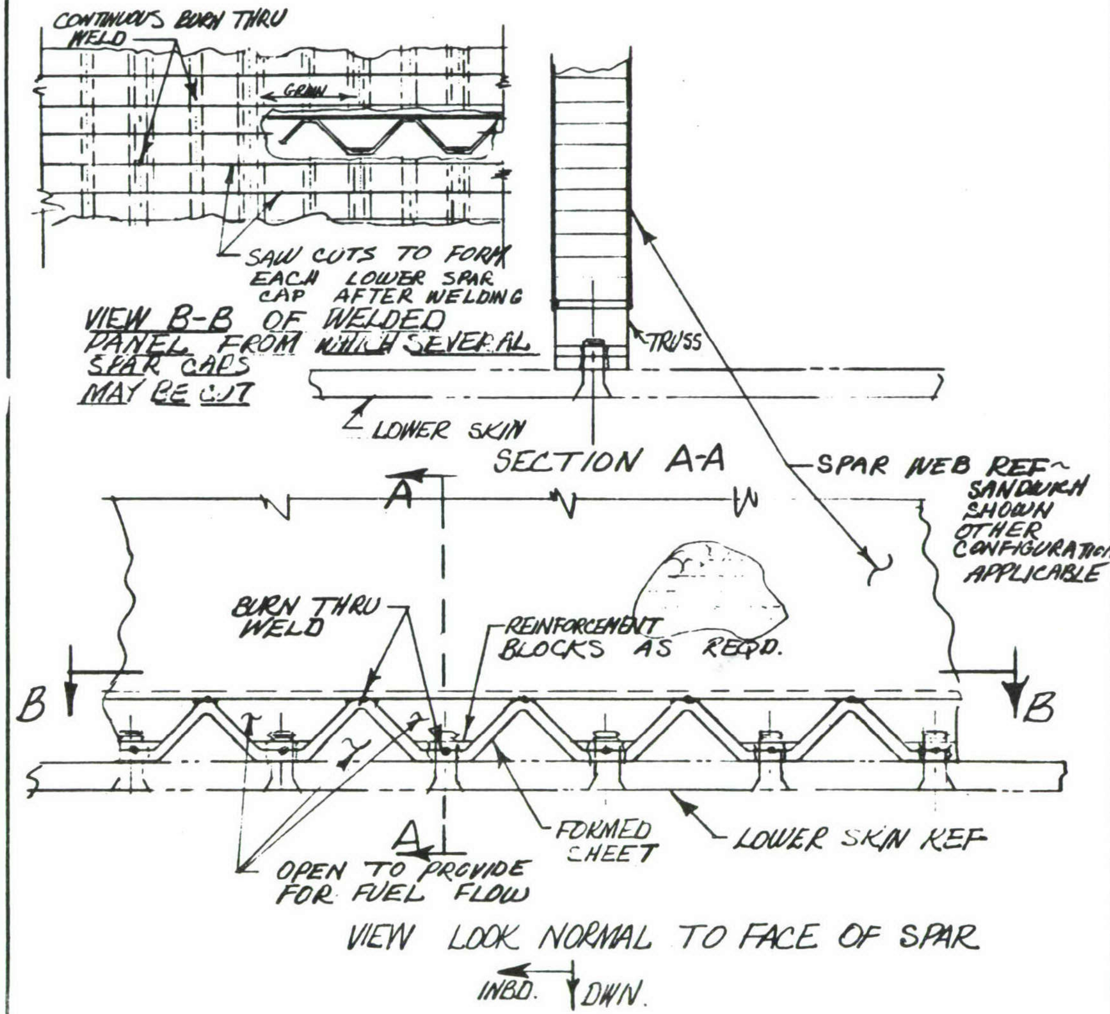
CONCEPT FEATURES

ADVANTAGES~
1. FAIL SAFE

DISADVANTAGES~
RIB INSTALLATION A PROBLEM.

PREPARED BY J.D. Rix... DATE 6/24/72

GENERAL DYNAMICS
Convair Aerospace Division
Fort Worth Operation



STRUCTURAL CONCEPT 610-213

TITLE SPAR CAP – WELDED TRUSS/FLOW HOLE FOR ATTACHMENT WITH MECHANICAL FASTENERS

CONCEPT DESCRIPTION LOWER SPAR CAP MEMBER OF A WELDED TRUSS CONFIGURATION THAT PROVIDES FUEL FLOW HOLES. FORMED TRUSS MEMBER IS FIRST WELDED TO A FULL WIDTH SHEET THEN SAWED INTO INDIVIDUAL CAPS.

APPLICATION INTERMEDIATE SPAR CAP WHERE FUEL FLOW HOLES ARE REQD.

MATERIALS TITANIUM, STEEL OR WELDABLE ALUMINUM

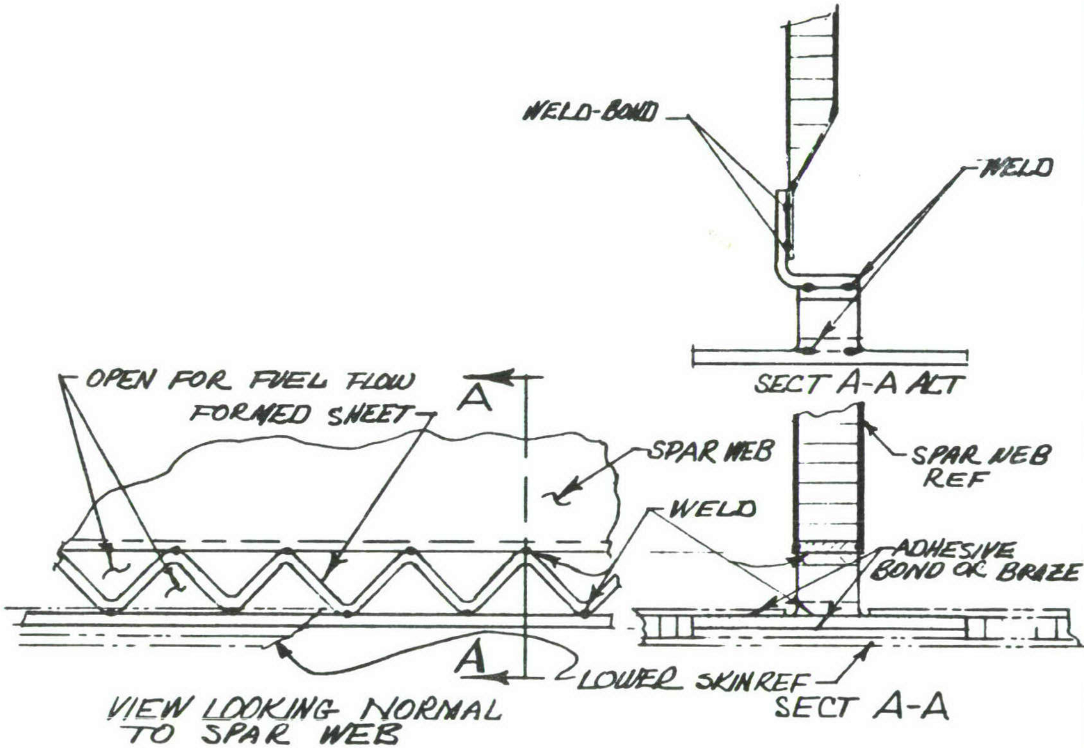
LOAD RANGE 100 TO 10,000 #/IN SHEAR FLOW

CONCEPT FEATURES
- ECONOMICAL & EFFICIENT CONFIGURATION SPAR CAP WHERE FUEL FLOW HOLES ARE REQD.
- PROVIDES FUEL FLOW TO INNER SURFACE OF LOWER SKIN-(ELIMINATES "DEAD" FUEL)

NOTE: SEE 610-214 FOR ALT WHERE SPAR IS JOINED TO LOWER SKIN BY BRAZING OR ADH. BONDING IN LIEU OF MECH. FASTENERS

PREPARED BY R.W. McCarty DATE 6-26-72

GENERAL DYNAMICS
Convair Aerospace Division
Fort Worth Operation



STRUCTURAL CONCEPT 610-214

TITLE SPAR CAP ~ WELDED TRUSS / FLOW HOLE FOR JOINING TO LOWER SKIN BY BRAZING OR ADHESIVE BONDING

CONCEPT DESCRIPTION LOWER SPAR CAP WELDED TRUSS CONFIGURATION THAT PROVIDES FUEL FLOW HOLES. LOWER FLANGE OF TRUSS MEMBER IS OF SUFFICIENT WIDTH TO PROVIDE AREA FOR JOINING TO LOWER SKIN BY BRAZING OR ADHESIVE BONDING

APPLICATION INTERMEDIATE SPAR CAP MEMBER WHERE FUEL FLOW HOLES ARE REQD.

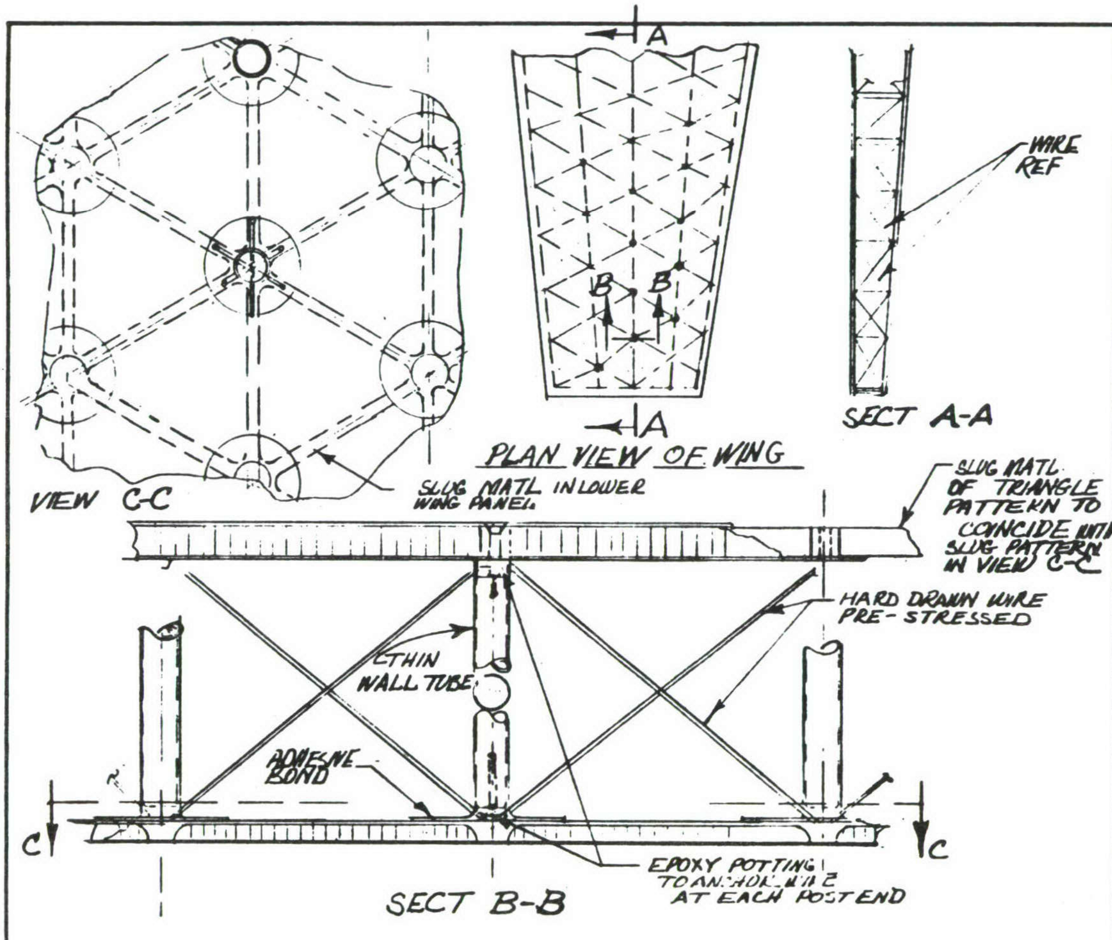
MATERIALS TITANIUM, STEEL OR WELDABLE ALUMINUM

LOAD RANGE 100 TO 10,000 #/IN SHEAR FLOW

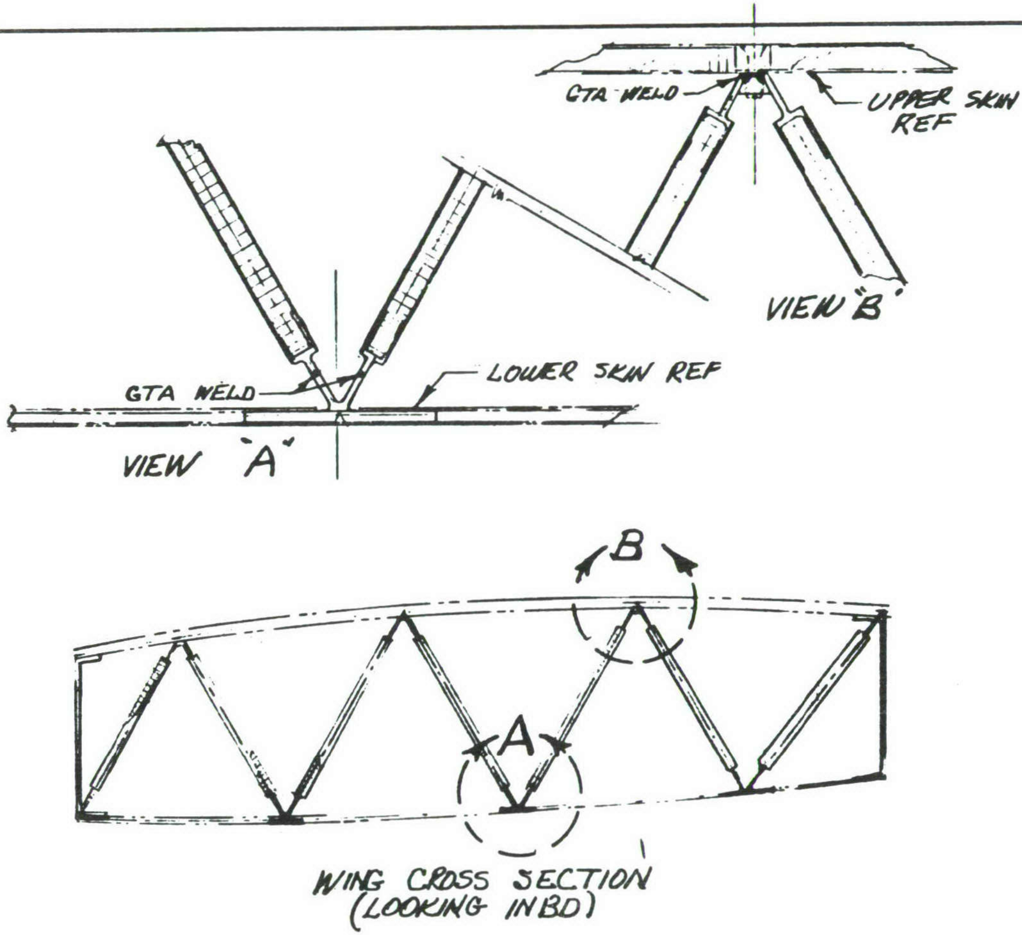
CONCEPT FEATURES
- ECONOMICAL & EFFICIENT CONFIGURATION SPAR CAP WHERE FUEL FLOW HOLES ARE REQD.
- CREATES "NO "DEAD" FUEL POCKETS

PREPARED BY R.W. McGinty DATE 6-26-72

GENERAL DYNAMICS
Convair Aerospace Division
Fort Worth Operation



STRUCTURAL CONCEPT	610-215
TITLE SPAR/BHD ~ TENSION WIRE TRUSS CONFIGURATION	
CONCEPT DESCRIPTION THIS CONCEPT UTILIZING A LATTICE OF TENSION WIRES & TUBULAR COLUMNS TO REPLACE INTERNAL SPARS AND BHDS IN A WING STRUCTURE. TRUSS CAPS ARE PROVIDED BY SLUG MATL WITHIN SAND. [illegible]	
APPLICATION INTERNAL WING STRUCTURE	
MATERIALS STEEL, TITANIUM & ALUMINUM	
LOAD RANGE ——	
CONCEPT FEATURES • UNRESTRICTED FUEL FLOW • MULTIPLE LOAD PATHS	
PREPARED BY [signature]	DATE 6-27-72
GENERAL DYNAMICS Convair Aerospace Division Fort Worth Operation	



STRUCTURAL CONCEPT 610-216

TITLE SPAR ~ DIAGONAL SANDWICH

CONCEPT DESCRIPTION
SPARS ARRANGED IN A DIAGONAL PATTERN TO PROVIDE WING STIFFNESS IN CHORDWISE PLANES WITHOUT CHORDWISE BNDS

APPLICATION
INTERNAL WING SPARS

MATERIALS TITANIUM, STEEL

LOAD RANGE 1000 – 20,000 #/IN SHEAR FLOW

CONCEPT FEATURES
- MAKES POSIBLE THE ELIMINATION OF CHORDWISE BNDS.

PREPARED BY R.W. McAnelly DATE 6-30-72

GENERAL DYNAMICS
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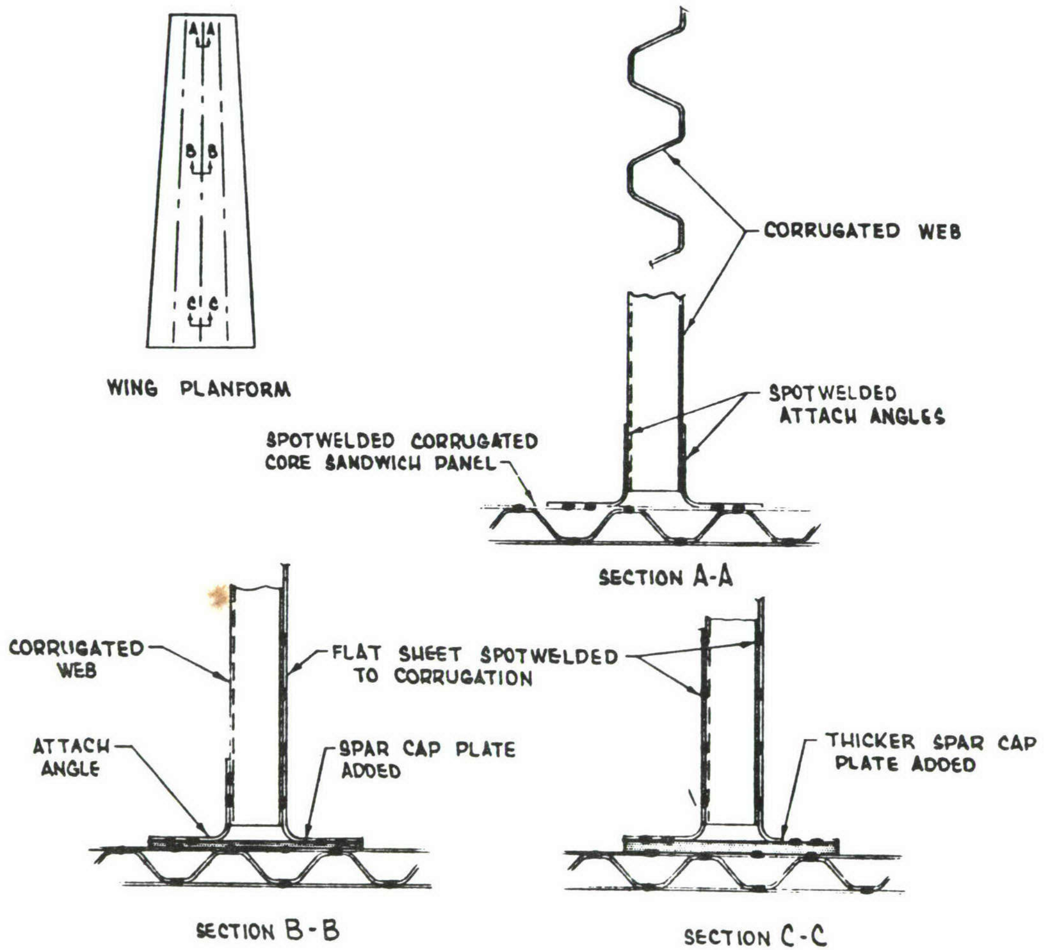
Fort Worth Operation



STRUCTURAL CONCEPT 610-217

TITLE SPAR AND SKIN PANEL-CONSTRUCTION CONCEPT

CONCEPT DESCRIPTION
SANDWICH SKIN PANELS AND SPARS ARE OF SPOTWELDED, CORRUGATED CONSTRUCTION

APPLICATION WING CONSTRUCTION

MATERIALS TITANIUM, STEEL

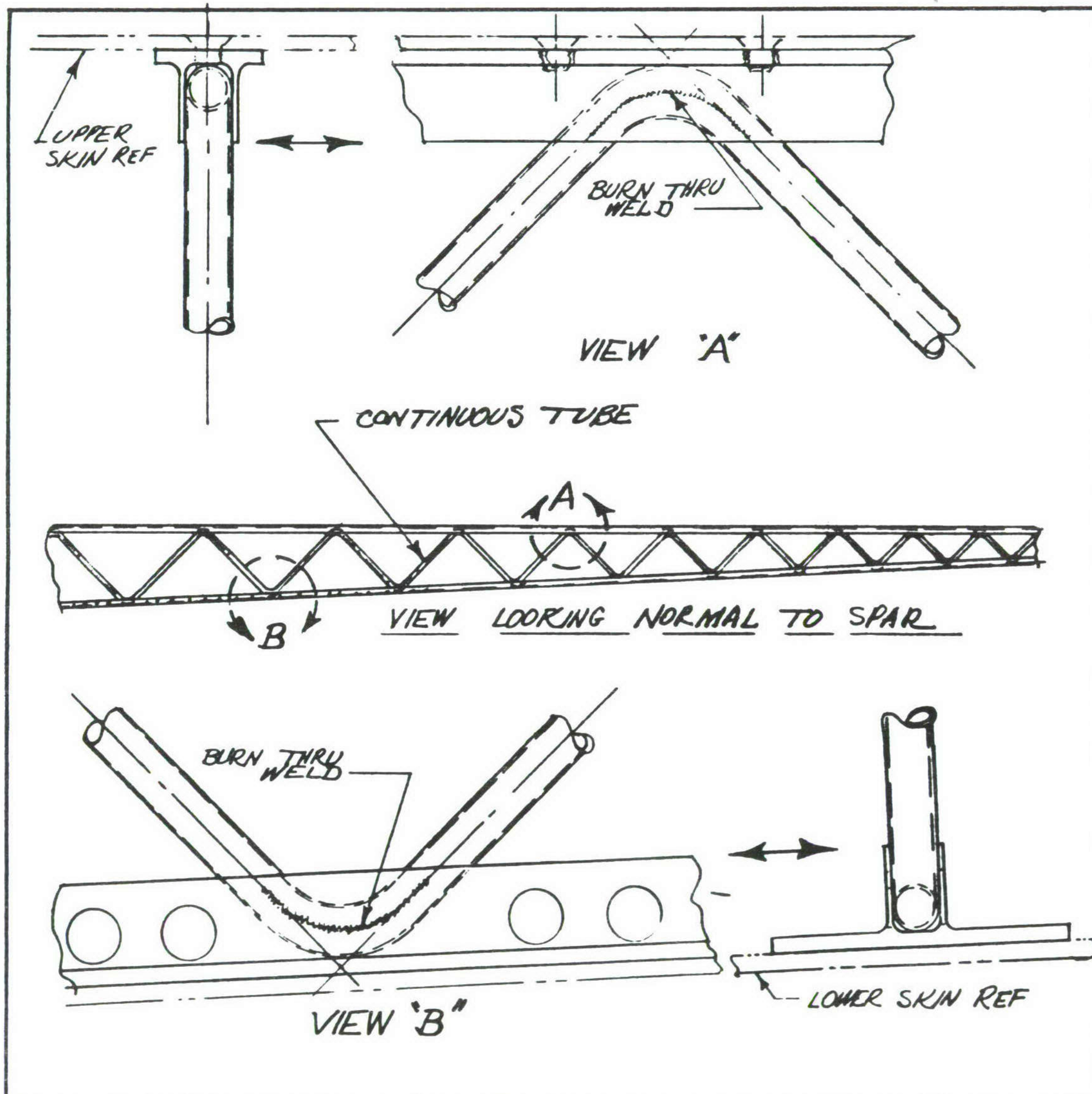
LOAD RANGE

CONCEPT FEATURES

- AS THE SHEAR LOAD INCREASES IN THE INBOARD DIRECTION, THE GAGE OF THE CORRUGATION IN THE SKIN PANELS AND IN THE SPAR WEBS MAY BE INCREASED, SPAR CAP PLATES MAY BE ADDED, AND THE CORRUGATED SPAR WEBS MAY BE STABILIZED BY ADDING SPOTWELDED FLAT SHEETS
- FASTENERS THROUGH LOWER SURFACE SKIN ARE ELIMINATED
- CONCEPT MAY BE ADAPTED TO BRAZED TITANIUM HONEYCOMB PANEL CONSTRUCTION

PREPARED BY S. E. Bloom DATE 7.7.72

GENERAL DYNAMICS
Convair Aerospace Division
Fort Worth Operation



STRUCTURAL CONCEPT 610-218

TITLE SPAR ~ TRUSS WITH CONTINUOUS TUBULAR DIAGONAL MEMBER

CONCEPT DESCRIPTION
CONCEPT CONSISTS OF SPAR MADE UP OF CHANNEL CAPS WITH CONTINUOUS TUBULAR DIAGONAL MEMBER WELDED TO CAPS

APPLICATION
INTERNAL SPAR OR WING BHD.

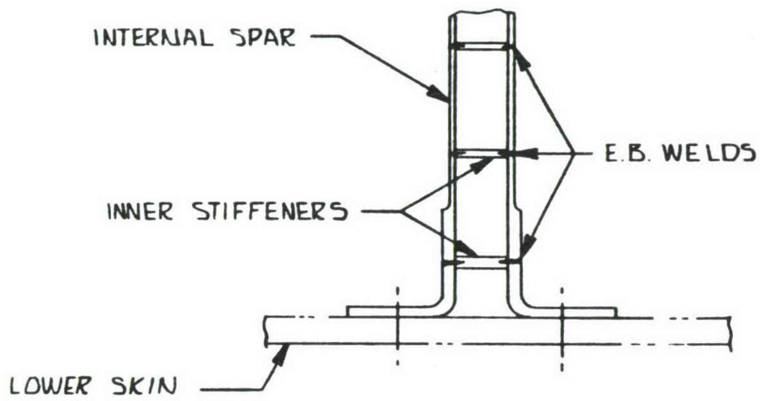
MATERIALS TITANIUM, STEEL OR ALUMINUM

LOAD RANGE

CONCEPT FEATURES
• ECONOMICAL TO MANUFACTURE

PREPARED BY B.W. McAnally DATE 7/12/72

GENERAL DYNAMICS
Convair Aerospace Division
Fort Worth Operation



STRUCTURAL CONCEPT 610-219

TITLE SPAR, 2 PIECE, WELDED STIFFENERS

CONCEPT DESCRIPTION~ SPAR HALVES ARE CHEM-ETCHED AND FORMED. INNER STIFFENERS ARE E.B. WELDED IN PLACE.

APPLICATION
INTERNAL SPAR

MATERIALS
BETA III OR B-B-Z-3 TITANIUM

LOAD RANGE

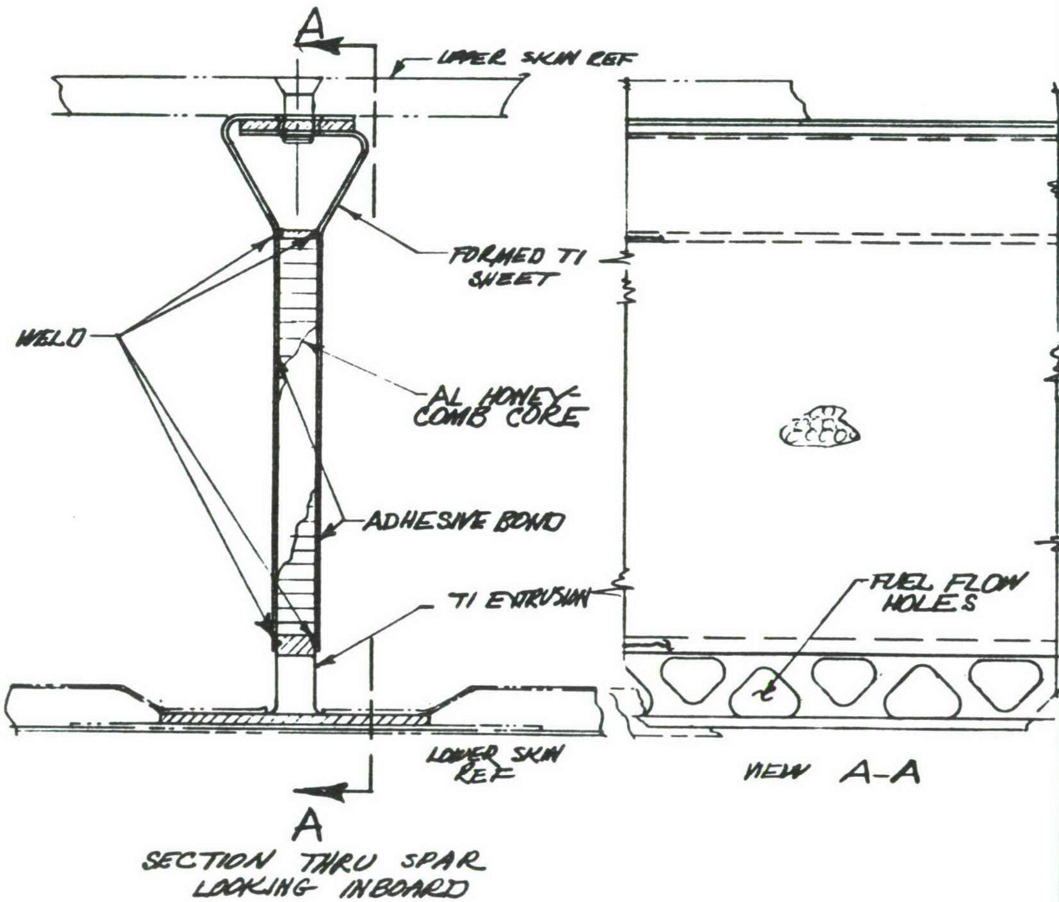
CONCEPT FEATURES

ADVANTAGES~
1. SAME AS DWG NOS. 610-402 AND 610-403

DISADVANTAGES~
1. SAME AS DWG NO. 610-403

PREPARED BY J.D. Bixler DATE 7/13/72

GENERAL DYNAMICS
Convair Aerospace Division
Fort Worth Operation



STRUCTURAL CONCEPT 610-220

TITLE SPAR ~ INTERMEDIATE, WEBS & UPPER CAP OF FORMED SHEET

CONCEPT DESCRIPTION
INTERMEDIATE SPAR CONCEPT WITH FORMED SHEETS JOINED BY WELDING & STIFFENED BY ADHESIVE BONDED HONEY COMB CORE

APPLICATION
INTERMEDIATE SPAR OR BHD.

MATERIALS TITANIUM

LOAD RANGE 500 - 18000 #/IN SHEAR FLOW

CONCEPT FEATURES
- LIGHTWEIGHT
- MINIMUM WASTE OF TI MATERIAL
- EFFICIENT MEANS OF INCORPORATING FUEL FLOW HOLES

PREPARED BY [signature] DATE 7/17/72

GENERAL DYNAMICS
Convair Aerospace Division
Fort Worth Operation

STRUCTURAL CONCEPT 610-221

TITLE SPAR ~ INTERNAL ATTACHMENT TO LOWER SKIN WITH FUEL FLOW PROVISIONS IN SPAR

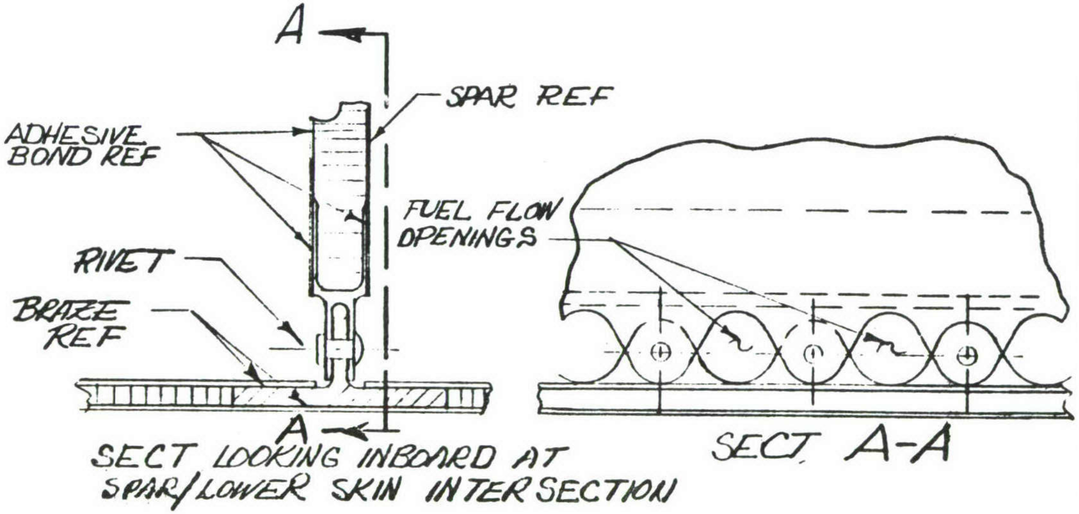
CONCEPT DESCRIPTION
SPAR TO LOWER SKIN JOINT WITH FUEL FLOW PROVISION THAT HAS LOW K_T VALUE

APPLICATION
INTERNAL SPAR WHERE FUEL FLOW PROVISION IS REQD.

MATERIALS TITANIUM, STEEL

LOAD RANGE 500 - 5000 #/IN SHEAR [illegible] WITH HIGH AXIAL LOAD [illegible]

CONCEPT FEATURES
• PROVIDES LOW K_t VALUE IN LOWER EDGE OF SPAR & LOWER SKIN, THEREBY PERMITTING HIGH CYCLIC TENSION STRESS IN LOWER SKIN WITHOUT DECREASING FATIGUE LIFE OF LOWER SKIN.

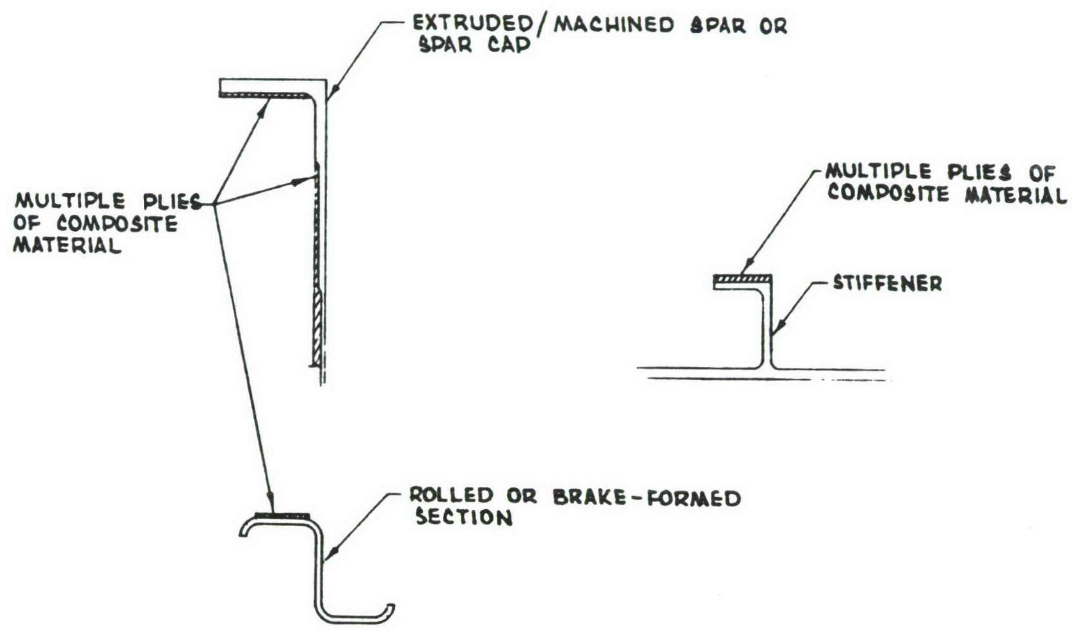


PREPARED BY [signature] **DATE** [illegible]

GENERAL DYNAMICS
Convair Aerospace Division
Fort Worth Operation

FORWARD AND AFT SPAR CONCEPTS

SKETCHES 610-300 THROUGH 308



STRUCTURAL CONCEPT 610-300

TITLE
SPAR (OR SPAR CAP), STIFFENED

CONCEPT DESCRIPTION
COMPOSITE MATERIAL USED FOR LOCAL, SELECTIVE STRENGTHENING OF STRUCTURAL ELEMENTS

APPLICATION
VIRTUALLY ALL TYPES OF STRUCTURAL ELEMENTS USED IN A WING BOX

MATERIALS
ALUMINUM, TITANIUM, STEEL

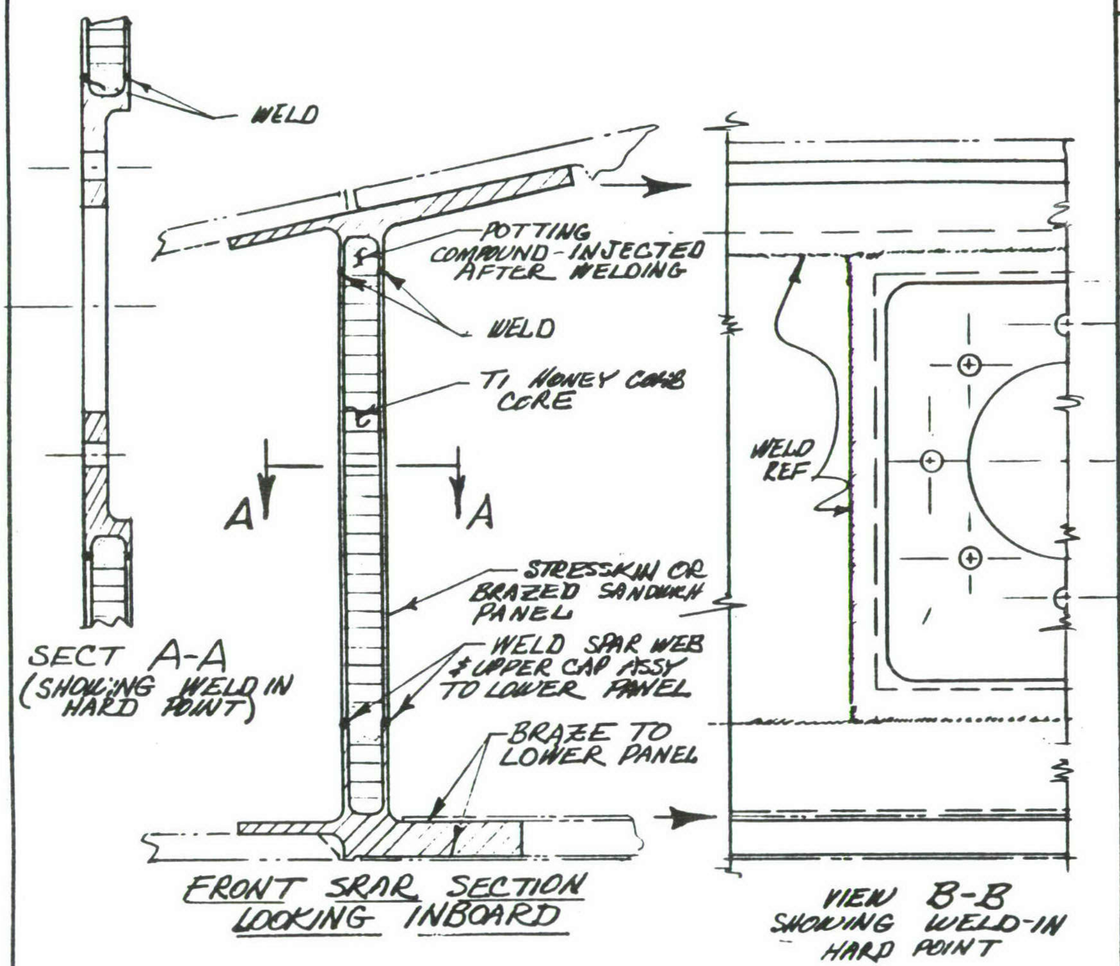
LOAD RANGE

CONCEPT FEATURES

- THIS DESIGN CONCEPT PROVIDES A MEANS OF IMPROVING THE STRENGTH/WEIGHT RATIO OF STRUCTURAL ELEMENTS

PREPARED BY J. E. B[illegible] DATE 6.15.72

GENERAL DYNAMICS
Convair Aerospace Division
Fort Worth Operation



STRUCTURAL CONCEPT 610-301

TITLE SPAR — FWD/AFT, SANDWICH WEB WITH WELDED-ON CAPS & HARD POINTS

CONCEPT DESCRIPTION CONCEPT CONSISTS OF LOWER CAP BRAZED INTO LOWER PANEL WELD JOINED TO SANDWICH WEB, MACHINED HARDPOINT & UPPER CAP WELDED ASSY

APPLICATION
FRONT OR REAR SPAR

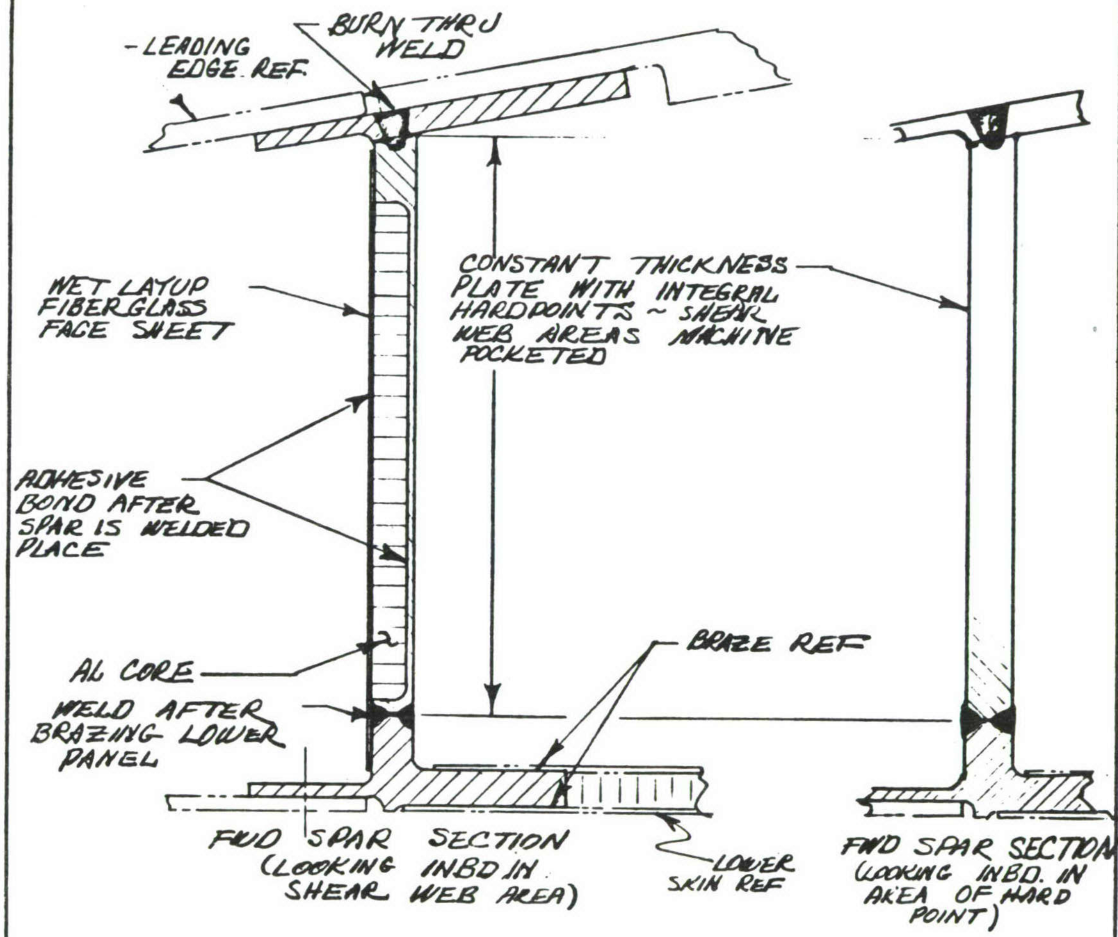
MATERIALS
TITANIUM OR STEEL

LOAD RANGE 300 — 15,000#/IN SHEAR

CONCEPT FEATURES
- MINIMUM WASTE OF TITANIUM AS COMPARED TO MACHINED SPAR
- MORE EFFICIENT THAN MACHINED SPAR

PREPARED BY [signature] DATE 7-18-72

GENERAL DYNAMICS
Convair Aerospace Division
Fort Worth Operation



STRUCTURAL CONCEPT 610-302

TITLE SPAR ~ FWD/REAR, MACHINED/SANDWICH WEB - WELD ON CAPS

CONCEPT DESCRIPTION FWD/REAR SPAR CONCEPT WITH CAPS WELDED TO MACHINED POCKETED PLATE. VERTICAL WEB STABILIZED IN THIN AREAS BY HONEYCOMB CORE & WET LAYUP FIBERGLASS FACING.

APPLICATION FRONT OR REAR SPAR

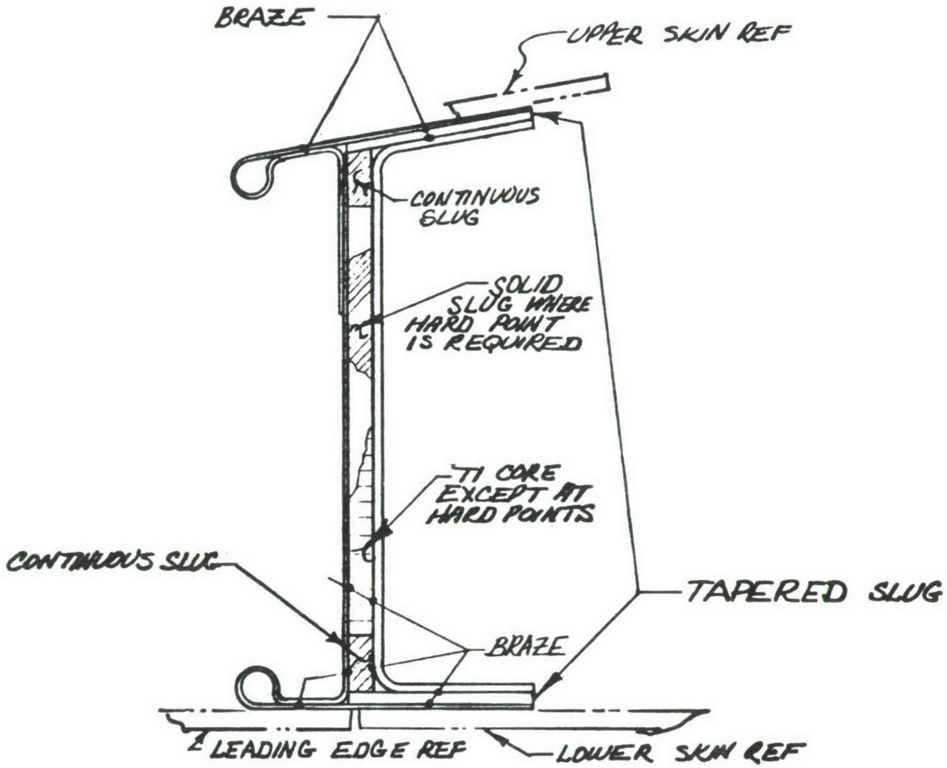
MATERIALS TITANIUM OR STEEL

LOAD RANGE 500 TO 15,000 #/IN SHEAR FLOW

CONCEPT FEATURES
- STRUCTURALLY EFFICIENT
- REDUCTION IN MATERIAL WASTE OVER MACHINED SPAR

PREPARED BY [signature] DATE 7-18-72

GENERAL DYNAMICS
Convair Aerospace Division
Fort Worth Operation



FRONT SPAR SECTION
(LOOKING INBOARD)

STRUCTURAL CONCEPT — 610-303

TITLE SPAR ~ FORWARD/REAR, BRAZED ASSY OF FORMED SHEET & SLUG/HONEY COMB CORE

CONCEPT DESCRIPTION
FRONT OR REAR SPAR CONCEPT MADE UP OF FORMED SHEET, SLUGS & TI HONEY COMB CORE

APPLICATION FRONT OR REAR SPARS

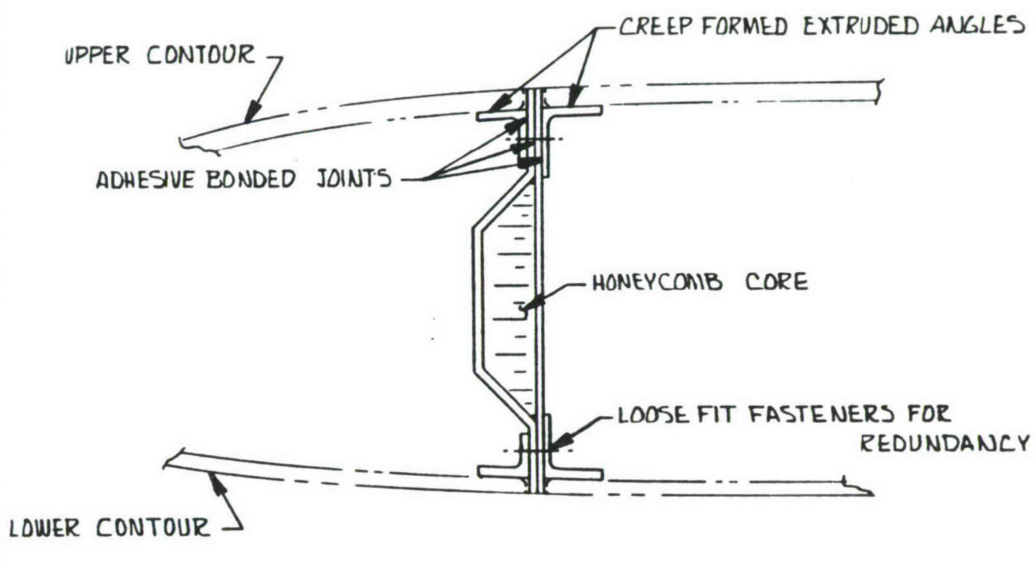
MATERIALS
TITANIUM OR STEEL

LOAD RANGE 500 TO 15000 PSI SHEAR FLOW

CONCEPT FEATURES
- HAS FAIL SAFE CHARACTERISTICS
- GOOD STRUCTURAL EFFICIENCY
- MINIMUM MATERIAL WASTE COMPARED TO MACHINED SPAR

PREPARED BY R.W. McAnally DATE 7-18-72

GENERAL DYNAMICS
Convair Aerospace Division
Fort Worth Operation



STRUCTURAL CONCEPT 610-304

TITLE SPAR, FWD/AFT; SANDWICH WEB, ADHESIVE BONDED CAPS.

CONCEPT DESCRIPTION ~ FLAT SHEET BLANKED FOR SPAR WEB; CORE USED TO STABILIZE WEB. CREEP FORMED EXTRUDED ANGLES ATTACHED FOR SPAR CAPS.

APPLICATION
FWD / REAR SPAR

MATERIALS
ALUMINUM OR TITANIUM

LOAD RANGE

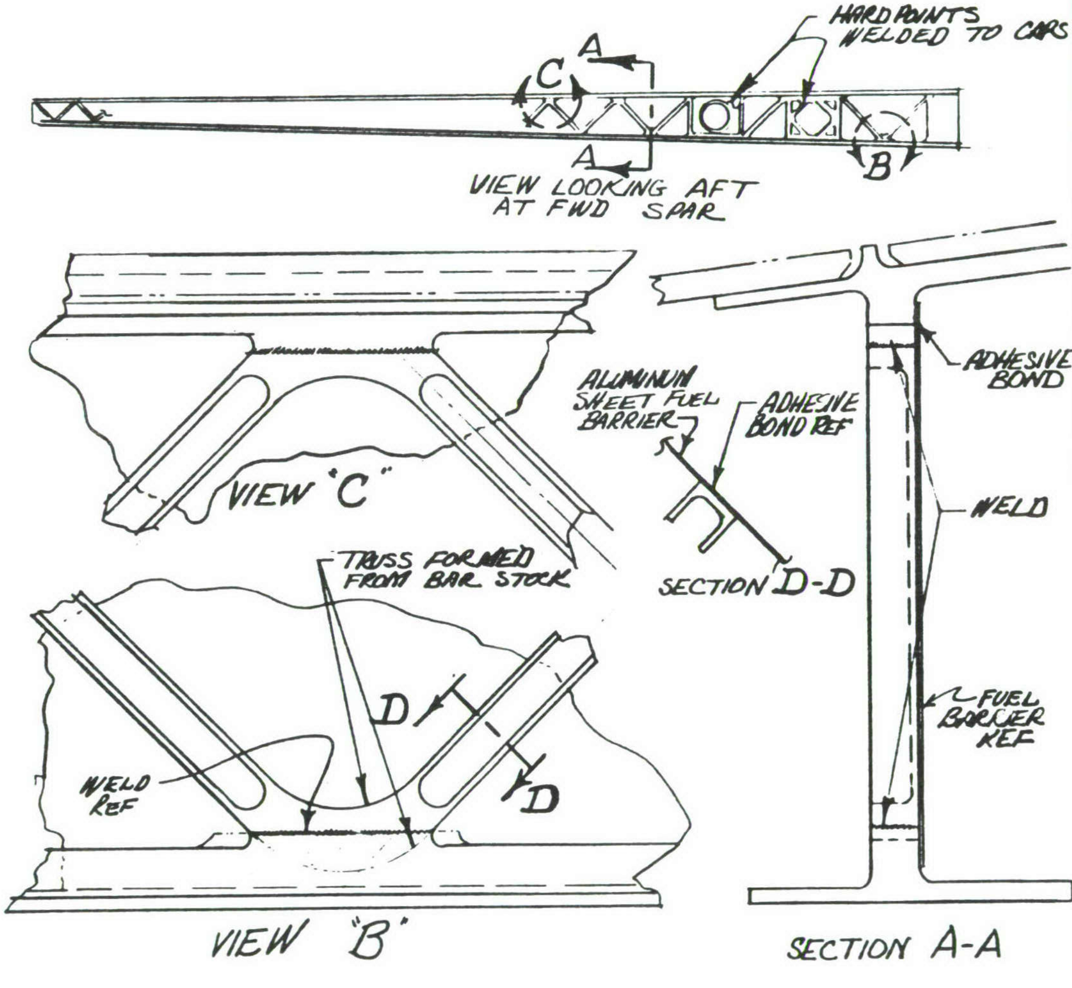
CONCEPT FEATURES

ADVANTAGES ~
1. FAIL SAFE DESIGN
2. SIMPLE MANUFACTURING

DISADVANTAGES ~
1. FITTINGS AND CUTOUTS DIFFICULT TO HANDLE

PREPARED BY J. O. Bixler | DATE 7/19/72

GENERAL DYNAMICS
Convair Aerospace Division
Fort Worth Operation



STRUCTURAL CONCEPT 610-305

TITLE SPAR ~ FORWARD/REAR, WELDED TRUSS WITH ADHESIVE BONDED ON FUEL BARRIER

CONCEPT DESCRIPTION FWD/REAR SPAR CONCEPT CONSTRUCTED OF EXTRUDED CAPS WITH DIAGONAL MEMBER OF FORMED BAR STOCK. DIAGONAL MEMBER & HARDPOINT MEMBERS ARE WELDED TO CAPS. A THIN ALUMINUM SHEET IS BONDED TO TRUSS TO FORM FUEL BARRIER.

APPLICATION FWD OR REAR SPAR

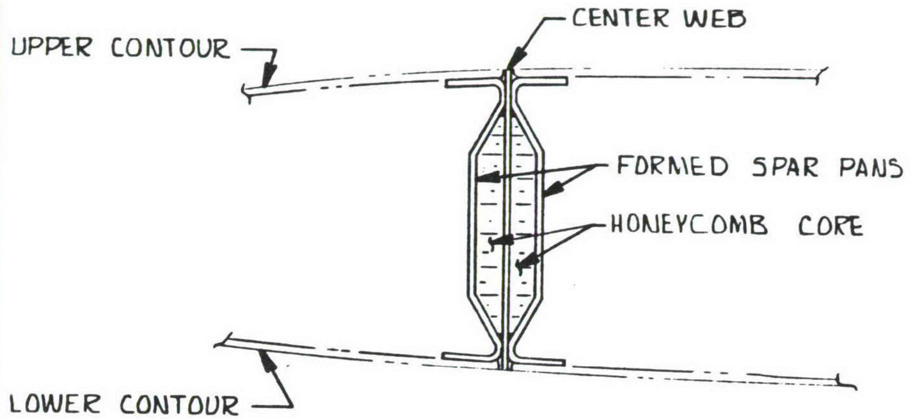
MATERIALS SPAR TRUSS IS TITANIUM OR STEEL—FUEL BARRIER IS AL.

LOAD RANGE 500 – 15,000 #/IN SHEAR

CONCEPT FEATURES
- MINIMUM MATERIAL WASTE AS COMPARED TO MACHINED SPAR

PREPARED BY R.W. McAnally DATE 7-19-72

GENERAL DYNAMICS
Convair Aerospace Division
Fort Worth Operation

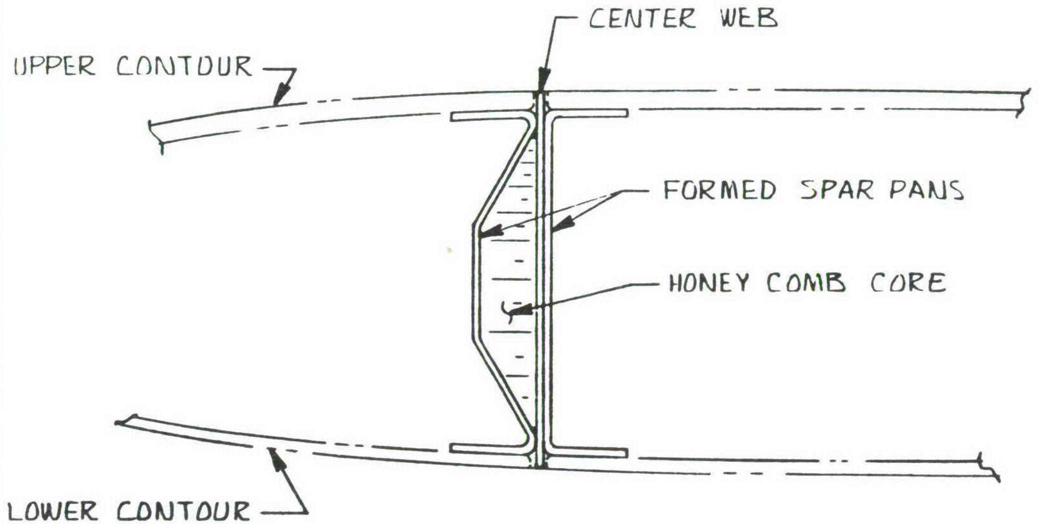


FABRICATION SEQUENCE ~

1. SIZE, ETCH, AND FORM SPAR PANS
2. DRAPE CORE INTO PANS AND ADHESIVE BOND
3. MACHINE CORE FLAT
4. BOND 2 PANS TO FLAT CENTER SHEET

STRUCTURAL CONCEPT	610-306
TITLE SPAR, FWD/AFT; SANDWICH WEB, FORMED CAPS	
CONCEPT DESCRIPTION ~ FLAT SHEET FORMED INTO PANS. PANS FILLED WITH CORE FOR STABILIZATION. FLAT SHEET BLANKED FOR CENTER WEB. PANS BONDED TO CENTER WEB.	
APPLICATION FWD/AFT SPAR	
MATERIALS ALUMINUM OR TITANIUM	
LOAD RANGE	
CONCEPT FEATURES ADVANTAGES ~ 1. FAIL SAFE DESIGN 2. SIMPLE MANUFACTURING 3. SYMETRICAL LOAD PATHS DISADVANTAGES ~ 1. SAME AS DWG NO 610-304 2. FUEL VOLUME IMPACTED.	
PREPARED BY W. Bixler	DATE 7/19/72

GENERAL DYNAMICS
Convair Aerospace Division
Fort Worth Operation



STRUCTURAL CONCEPT 610-307

TITLE SPAR, FWD/AFT; REDUNDANT CENTER WEB, SANDWICH STIFFENED

CONCEPT DESCRIPTION ~ FLAT SHEET FORMED INTO PANS OUTER PAN FILLED WITH CORE FOR STABILIZATION. FLAT SHEET BLANKED FOR CENTER WEB. PANS BONDED TO CENTER SHEET

APPLICATION
FWD/AFT SPAR

MATERIALS
ALUMINUM OR TITANIUM

LOAD RANGE

CONCEPT FEATURES

ADVANTAGES ~
1. FAIL SAFE DESIGN
2. SIMPLE MANUFACTURING

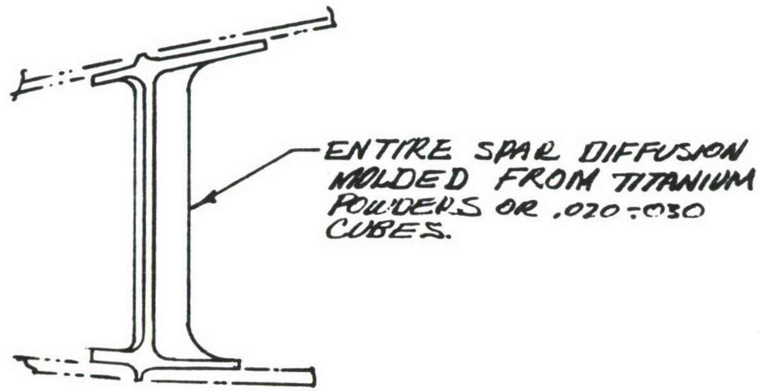
DISADVANTAGES ~
1. SAME AS DWG. NO. 610-304

PREPARED BY J. D. Bix Jr. DATE 7/19/72

GENERAL DYNAMICS
Convair Aerospace Division
Fort Worth Operation

STRUCTURAL CONCEPT	610-308
TITLE SPAR ~ DIFFUSION MOLDED	
CONCEPT DESCRIPTION SPAR CONCEPT THAT FABRICATES SPAR BY THE DIFFUSION MOLDING PROCESS FROM TITANIUM POWDERS OR .020-.030 CUBES	
APPLICATION SPARS OR BHDS	
MATERIALS TITANIUM	
LOAD RANGE 500 TO 20,000#/IN SHEAR	
CONCEPT FEATURES • ECONOMICAL HIGH PRODUCTION METHOD • GOOD PROPERTIES IN ALL PLANES • AN ADVANCED TECHNIQUE REQUIRING EXTENSIVE DEVELOPMENT	
PREPARED BY R.W. McAnelly	DATE 7-19-72

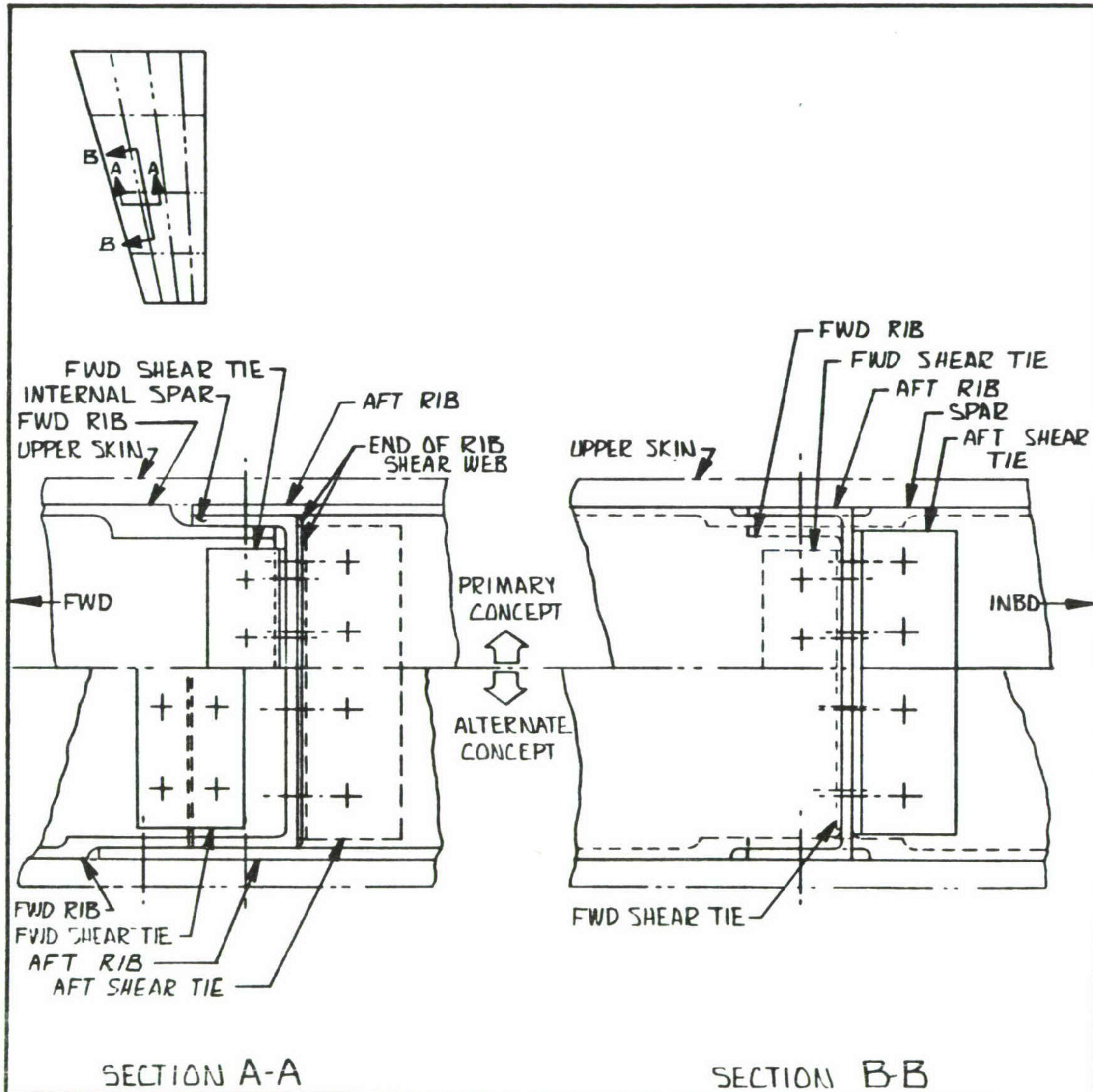
GENERAL DYNAMICS
Convair Aerospace Division
Fort Worth Operation



SECTION THRU FWD SPAR
(LOOKING INBD.)

SPLICE/JOINT CONCEPTS

SKETCHES 610-400 THROUGH 610-405



STRUCTURAL CONCEPT 610-400

TITLE SPLICE, SPAR-TO-RIB; FOR CONTINUOUS SPAR, OVERLAP JOINT

CONCEPT DESCRIPTION FORGED MACHINED RIBS ARE SPLICED TO SPAR USING OVERLAPPED CAPS. SHEAR CONTINUITY PROVIDED BY FORMED OR EXTRUDED ANGLES.

APPLICATION
SPAR-TO-RIB SPLICE

MATERIALS
ALUMINUM OR TITANIUM

LOAD RANGE

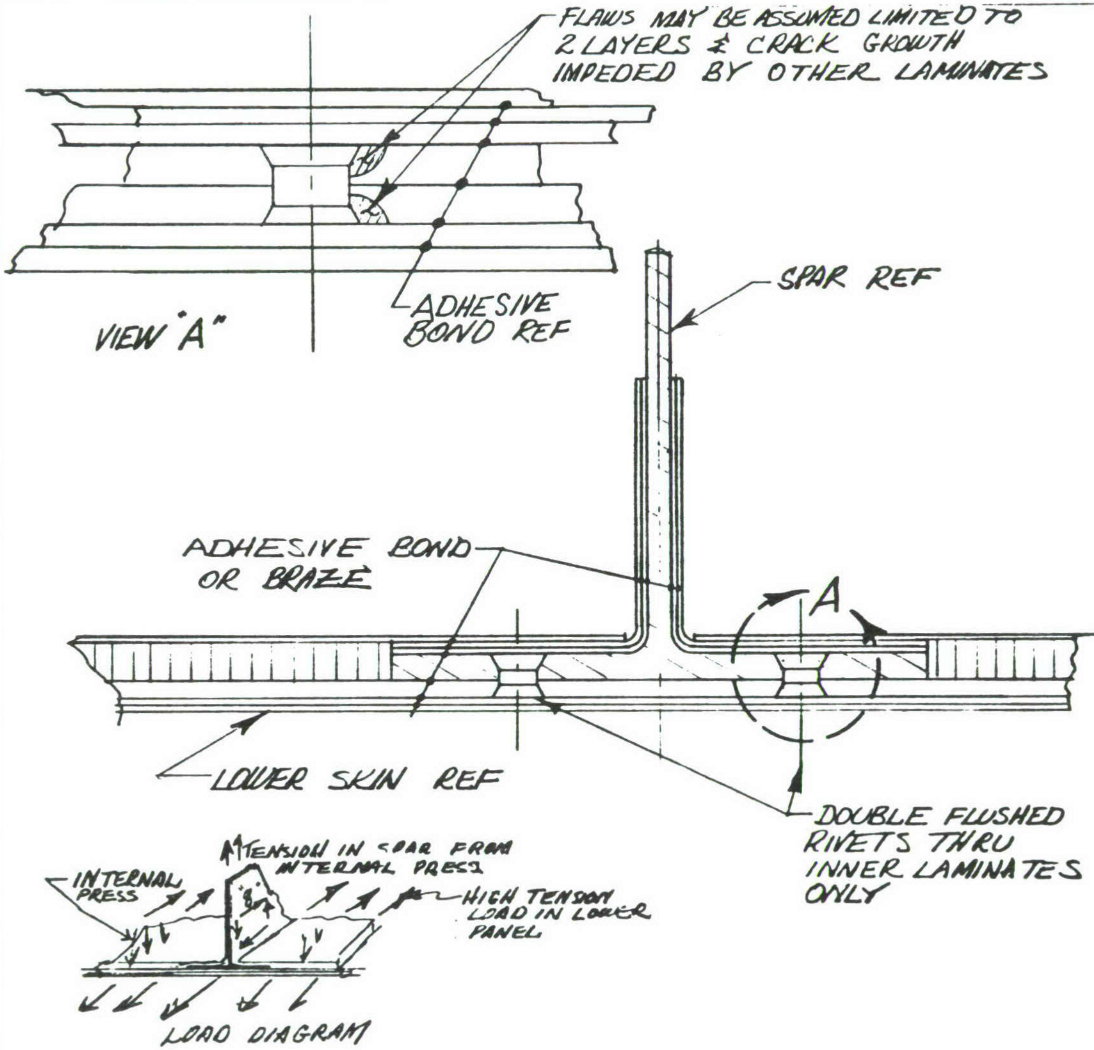
CONCEPT FEATURES

ADVANTAGES ~
1. CONTINUITY FOR CHORDWISE BENDING LOADS

DISADVANTAGES ~
1. MATING SURFACES DIFFICULT TO ALIGN
2. STRESS CONCENTRATION AT END OF RIB SHEAR WEB

PREPARED BY J. D. Bixler DATE 6/19/72

GENERAL DYNAMICS
Convair Aerospace Division
Fort Worth Operation



STRUCTURAL CONCEPT	610-401
TITLE JOINT — SPAR SHEAR & TENSION ATTACHMENT TO LOWER SKIN	

CONCEPT DESCRIPTION
COMBINATION RIVETED & BONDED STRUCTURAL JOINT IN LAMINATED STRUCTURE WITH RIVETS THRU INNER LAYERS WITH OUTER LAYERS NOT PIERCED BY HOLES

APPLICATION
SPAR TO LOWER TENSION SKIN ATTACHMENT

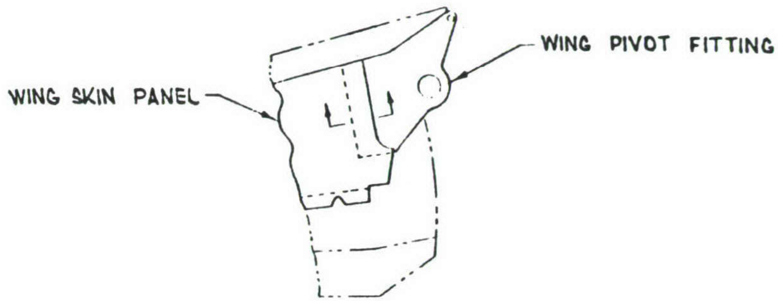
MATERIALS
ALL

LOAD RANGE ———

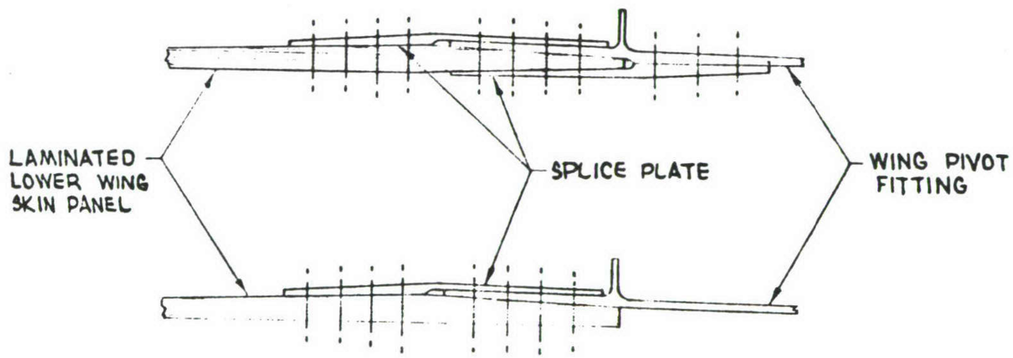
CONCEPT FEATURES
- IMPROVES DAMAGE TOL. OF STRUCTURE AT JOINT WHILE PROVIDING A POSITIVE TENSION TIE BETWEEN SPAR & LOWER SKIN

PREPARED BY RWMcKinealy DATE 6-30-72

GENERAL DYNAMICS
Convair Aerospace Division
Fort Worth Operation



SPLICE DESIGN



ALTERNATE

STRUCTURAL CONCEPT 610-402

TITLE SPLICE - LOWER SKIN PANEL TO WING PIVOT FITTING (LAMINATED SKIN)

CONCEPT DESCRIPTION
LAMINATED AL OR TI SKIN PANEL ATTACHED TO THE WING PIVOT FITTING WITH TI SPLICE PLATES

APPLICATION
WING TENSION SKIN

MATERIALS ALUMINUM, TITANIUM

LOAD RANGE

CONCEPT FEATURES

- FAIL - SAFE DESIGN
- DESIGN WITH INNER AND OUTER SPLICE PLATES MINIMIZES ECCENTRICITY IN LOAD PATHS

PREPARED BY D. E. [illegible] DATE 8-2-72

GENERAL DYNAMICS
Convair Aerospace Division
Fort Worth Operation

STRUCTURAL CONCEPT	610-40[illegible]

TITLE SPLICE - HONEYCOMB SKIN PANEL TO WING PIVOT FITTING

CONCEPT DESCRIPTION
HONEYCOMB SANDWICH PANEL SPLICED TO PIVOT FTG. WITHOUT SPLICE PLATES

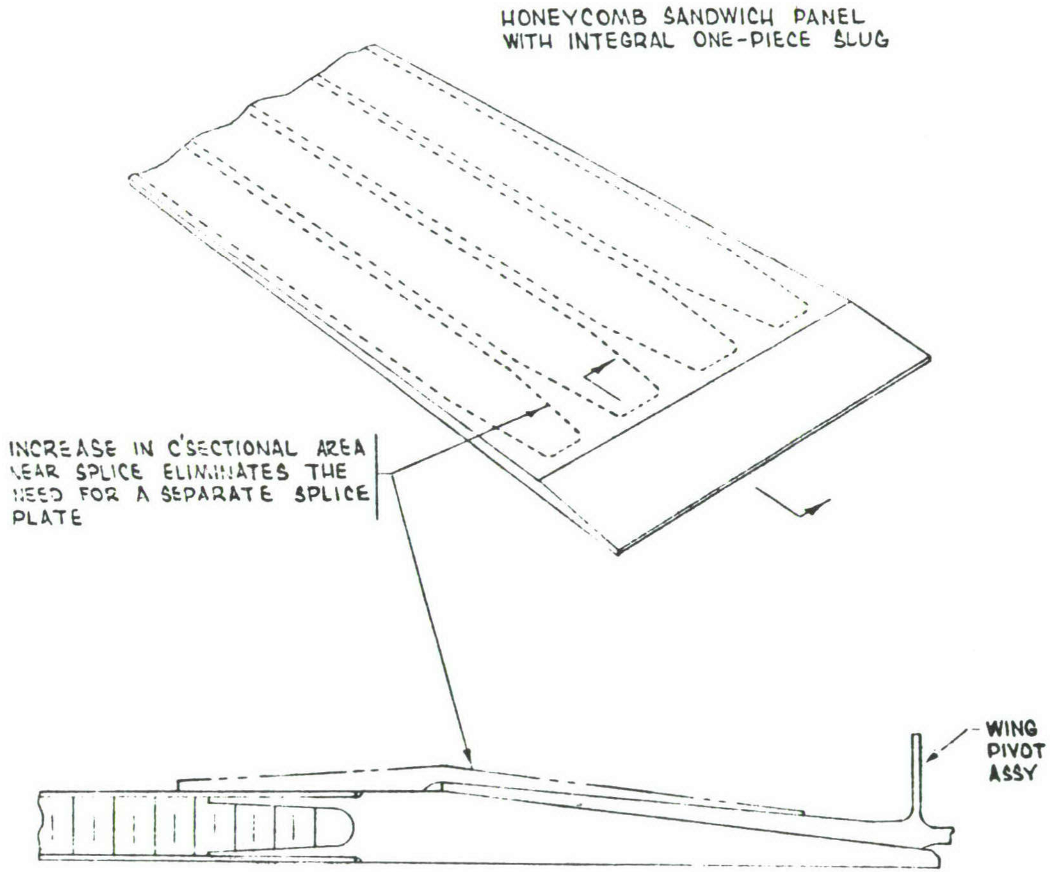
APPLICATION
WING SKIN PANEL

MATERIALS
ALUMINUM, TITANIUM

LOAD RANGE

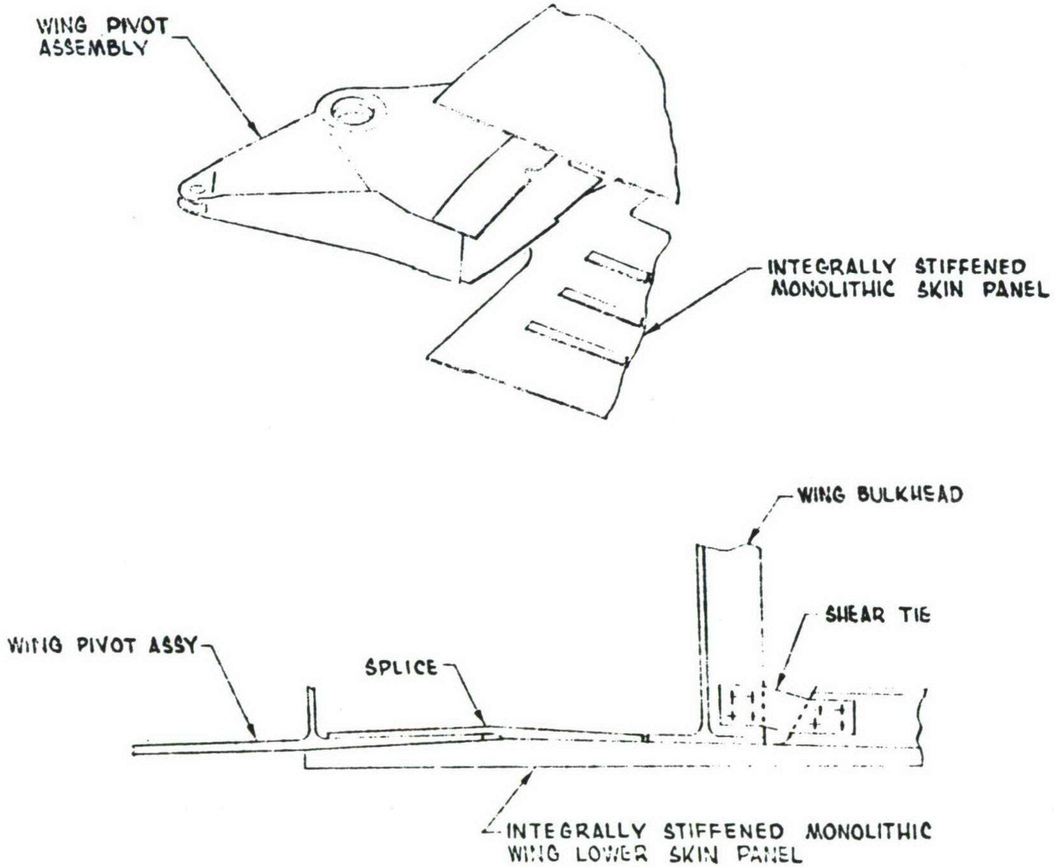
CONCEPT FEATURES

- ELIMINATES NEED FOR SEPARATE SPLICE PLATE



PREPARED BY D. E. Brown **DATE** 8-4-72

GENERAL DYNAMICS
Convair Aerospace Division
Fort Worth Operation



STRUCTURAL CONCEPT 610-10[illegible]

TITLE
SPLICE - INTEGRALLY STIFFENED SKIN TO WING PIVOT FITTING

CONCEPT DESCRIPTION
LOAD CONTINUITY FROM WING BOX TO PIVOT FITTING ACHIEVED WITH SPLICE PLATES AND SHEAR TIES AT STIFFENERS

APPLICATION
WING LOWER SURFACE

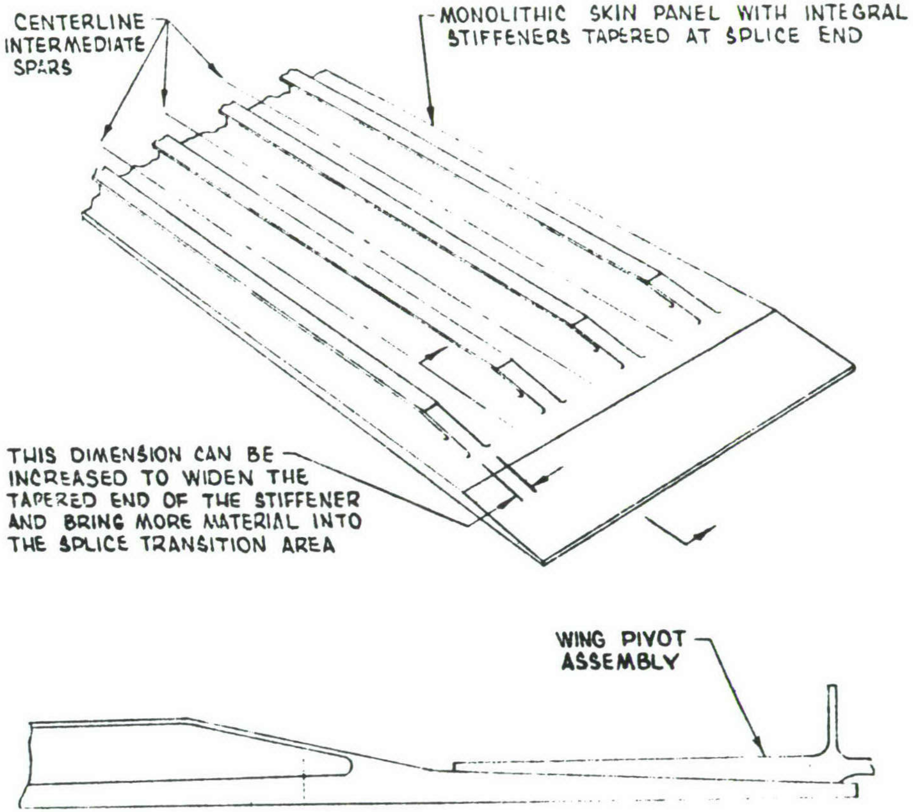
MATERIALS
ALUMINUM, TITANIUM

LOAD RANGE

CONCEPT FEATURES
SIMPLE, MINIMAL COST DESIGN

PREPARED BY [illegible] **DATE** 5-23-72

GENERAL DYNAMICS
Convair Aerospace Division
Fort Worth Operation

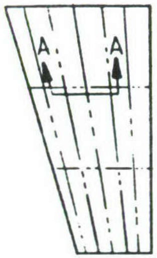


STRUCTURAL CONCEPT	610-405
TITLE: SPLICE - WING LOWER SKIN TO PIVOT FITTING	
CONCEPT DESCRIPTION: INTEGRALLY STIFFENED SKIN PANEL JOINED TO PIVOT FITTING WITHOUT SPLICE PLATES	
APPLICATION: WING LOWER SURFACE	
MATERIALS: ALUMINUM, TITANIUM	
LOAD RANGE	
CONCEPT FEATURES	
PREPARED BY: D. E. Bloom	DATE: 5·23·72

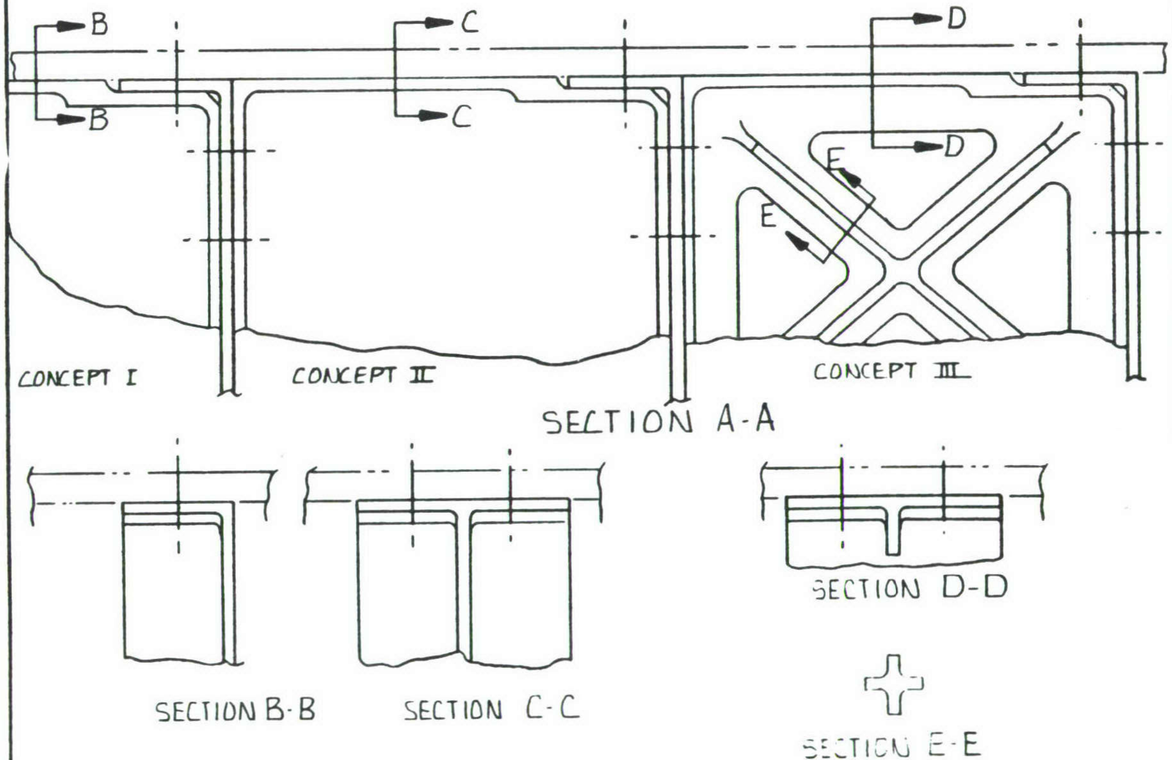
GENERAL DYNAMICS
Convair Aerospace Division
Fort Worth Operation

RIB/BULKHEAD CONCEPTS

SKETCHES 610-500 THROUGH 610-502



MANUFACTURING METHODS ~
1. MACHINE FROM PLATE (Al, Ti, OR STEEL)
2. MACHINE FROM FORGING (Al, Ti, OR STEEL)
3. DIFFUSION BOND (Ti)
4. DIFFUSION MOLD (Ti)
5. CASTING (Al, Ti, OR STEEL)



STRUCTURAL CONCEPT

610-500

TITLE RIB, NON CONTINUOUS; BATH TUB TYPE

CONCEPT DESCRIPTION ONE PIECE BATH TUB TYPE FITTINGS ARE PLACED BETWEEN EACH CONTINUOUS SPAR. SEVERAL MANUFACTURING METHODS SUGGESTED.

APPLICATION
RIBS

MATERIALS
ALUMINUM, TITANIUM, OR STEEL

LOAD RANGE

CONCEPT FEATURES
ADVANTAGES ~
1. STRENGTH
2. EASE OF MANUFACTURE

DISADVANTAGES ~
1. WEIGHT

PREPARED BY J. D. Bixler

DATE 612017Z

GENERAL DYNAMICS
Convair Aerospace Division
Fort Worth Operation

STRUCTURAL CONCEPT 610-501

TITLE RIB, NONCONTINUOUS; FORMED PAN WITH SANDWICH SHEAR WEB

CONCEPT DESCRIPTION SHEET MATERIAL HYDROFORMED INTO PANS. PANS BONDED TO CORE. EDGE OF CORE SEALED WITH FIBERGLAS WRAP. CONTINUOUS STRIP USED TO FORM CAP.

APPLICATION
RIBS

MATERIALS
ALUMINUM OR TITANIUM

LOAD RANGE

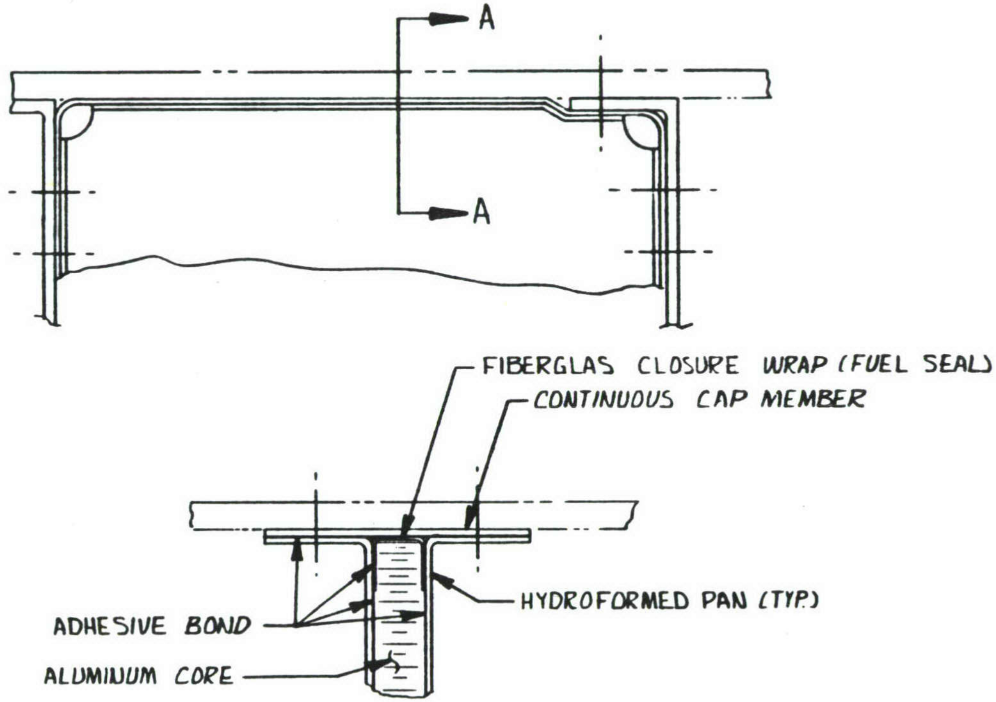
CONCEPT FEATURES

ADVANTAGES~
1. FAIL SAFE
2. GOOD STABILITY

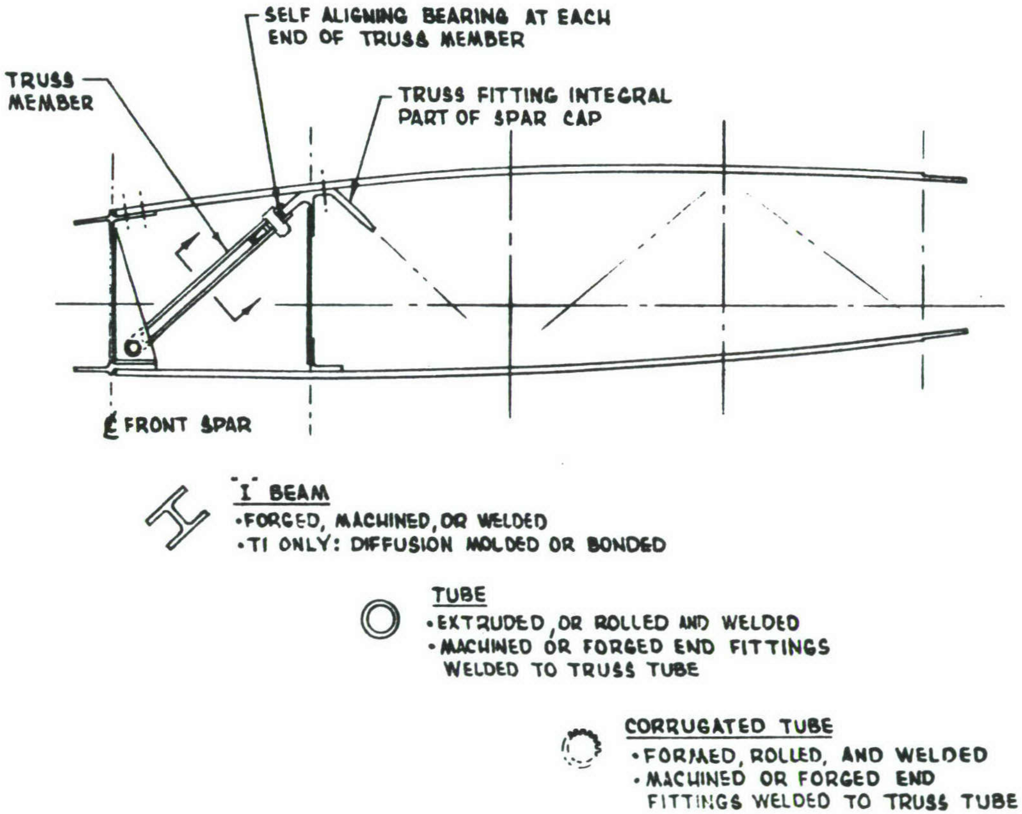
DISADVANTAGES~
1. FUEL SEALING A PROBLEM

PREPARED BY J. D. Bixler **DATE** 6/20/72

GENERAL DYNAMICS
Convair Aerospace Division
Fort Worth Operation



SECTION A-A



STRUCTURAL CONCEPT 610-502

TITLE
RIB – TRUSS MEMBER

CONCEPT DESCRIPTION
WING RIB CONSTRUCTED OF TRUSS MEMBERS ATTACHED TO SPAR FITTINGS WITH SELF ALIGNING CONNECTIONS

APPLICATION
WING RIB

MATERIALS
ALUMINUM, TITANIUM, STEEL

LOAD RANGE

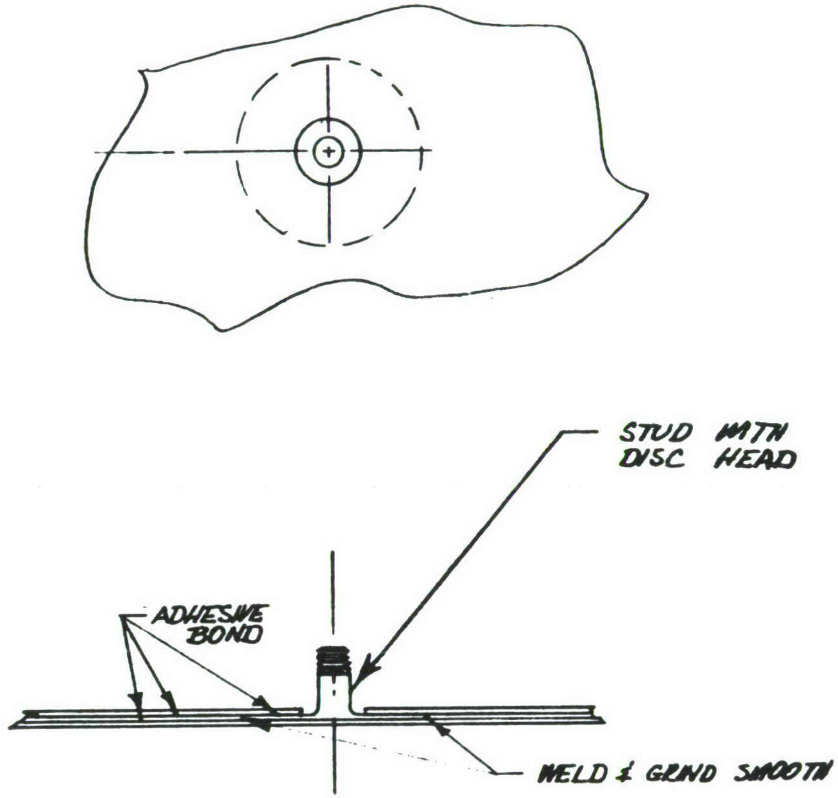
CONCEPT FEATURES
- TRUSS MEMBERS OF THE "I" BEAM OR PLAIN TUBE CONFIGURATION MAY BE REINFORCED WITH COMPOSITE MATL.
- HIGH LOAD CONCENTRATIONS MAY BE REACTED BY MULTIPLE TRUSSES ARRANGED SIDE-BY-SIDE TO PROVIDE FAIL SAFE FEATURE

PREPARED BY D. E. Boone   DATE 7.6.72

GENERAL DYNAMICS
Convair Aerospace Division
Fort Worth Operation

JOINING (FASTENING) CONCEPTS

SKETCHES 610-600 AND 610-601



STRUCTURAL CONCEPT

610-600

TITLE STUD - INSTL IN ADHESIVE BONDED LAMINATED PANEL

CONCEPT DESCRIPTION
STUD INSTL. IN LAMINATED PANEL TO MINIMIZE EFFECT OF INITIAL FLAW SIZE FOR IMPROVED DAMAGE TOLERANCE

APPLICATION
FASTENING PROVISION FOR SPARS OR ENDS IN LOWER SKIN PANEL

MATERIALS ALL

LOAD RANGE ———

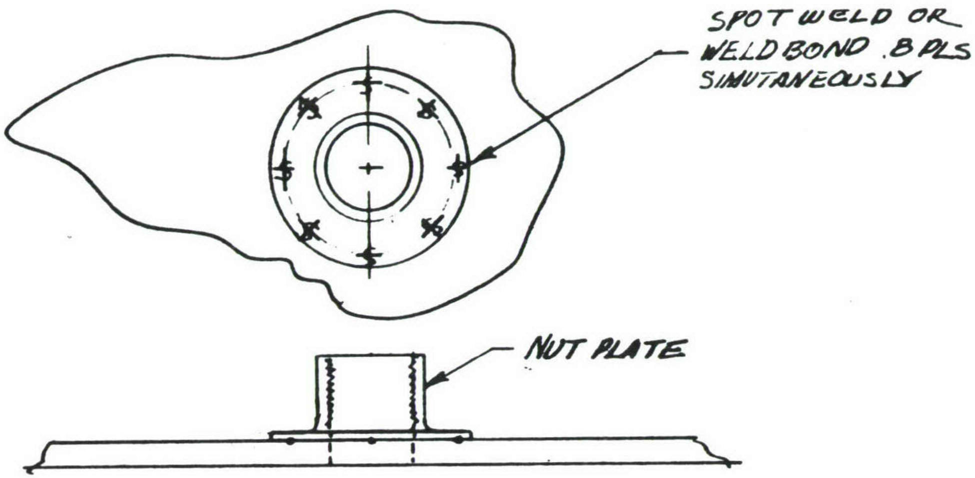
CONCEPT FEATURES

- MINIMIZES EFFECT OF INITIAL FLAW SIZE

ORIGIN: INNOVATION - E.D. GOMEZ

PREPARED BY D.W. McGinnity DATE 7-14-72

GENERAL DYNAMICS
Convair Aerospace Division
Fort Worth Operation



STRUCTURAL CONCEPT 610-601

TITLE NUT PLATE ~ WELD ON

CONCEPT DESCRIPTION
ANCHOR NUT PLATE BY MEANS OF SPOT WELDING OR WELD BONDING IN LIEU OF RIVETING

APPLICATION ALL NUT PLATE INSTLS.

MATERIALS ALL

LOAD RANGE ~

CONCEPT FEATURES

- ATTACH NUT PLATE TO STRUCTURE BY SPOT WELDING OR WELD BONDING IN LIEU OF RIVETING

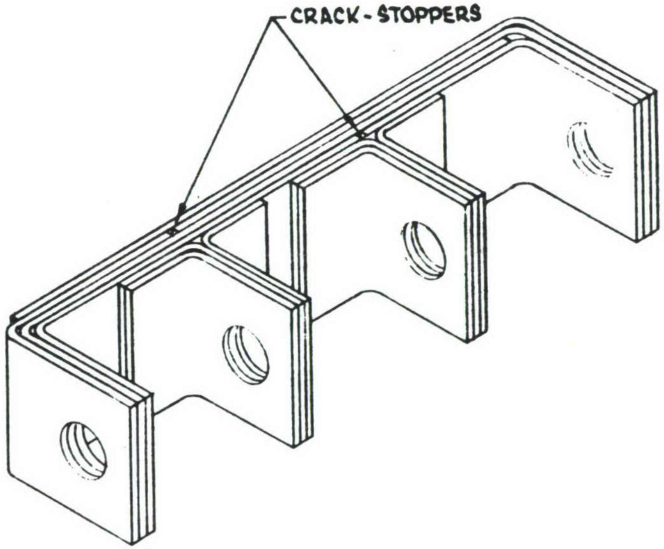
PREPARED BY [signature] DATE 7-14-72

GENERAL DYNAMICS
Convair Aerospace Division
Fort Worth Operation

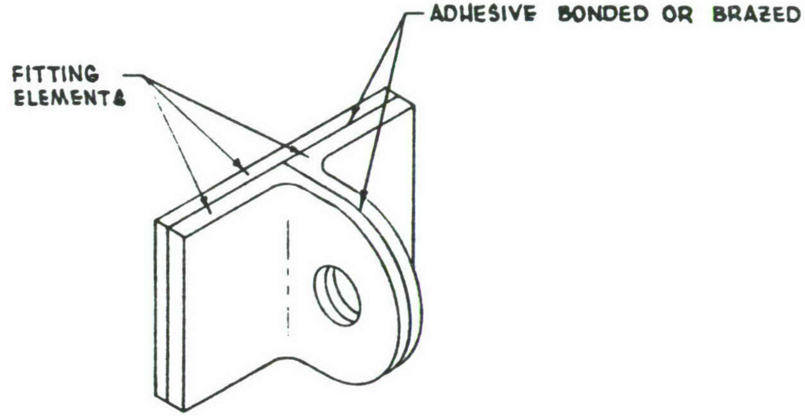
FITTING CONCEPTS

SKETCHES 610-700 THROUGH 610-705

ELEMENTS JOINED BY:
- ADHESIVE BONDING (ALUM & TI)
- BRAZING (TI)
- WELDING (ALUM, TI & STEEL)



STRUCTURAL CONCEPT	610-700
TITLE FITTING - LAMINATED	
CONCEPT DESCRIPTION FITTING IS MADE UP OF FORMED ELEMENTS WHICH ARE JOINED BY BONDING, BRAZING, OR WELDING	
APPLICATION LOAD FITTINGS	
MATERIALS ALUMINUM, TITANIUM, STEEL	
LOAD RANGE	
CONCEPT FEATURES • FAIL SAFE WITH ALTERNATE LOAD PATHS AND CRACK-STOPPING CAPABILITY • NO MACHINING	
PREPARED BY J. E. Bloom	DATE 6-27-72
GENERAL DYNAMICS Convair Aerospace Division Fort Worth Operation	



STRUCTURAL CONCEPT 610-701

TITLE
FITTING - BACK·TO·BACK

CONCEPT DESCRIPTION
FITTING ELEMENTS ARE BONDED OR BRAZED TOGETHER TO FORM A PART

APPLICATION
LOAD-CARRYING FITTINGS

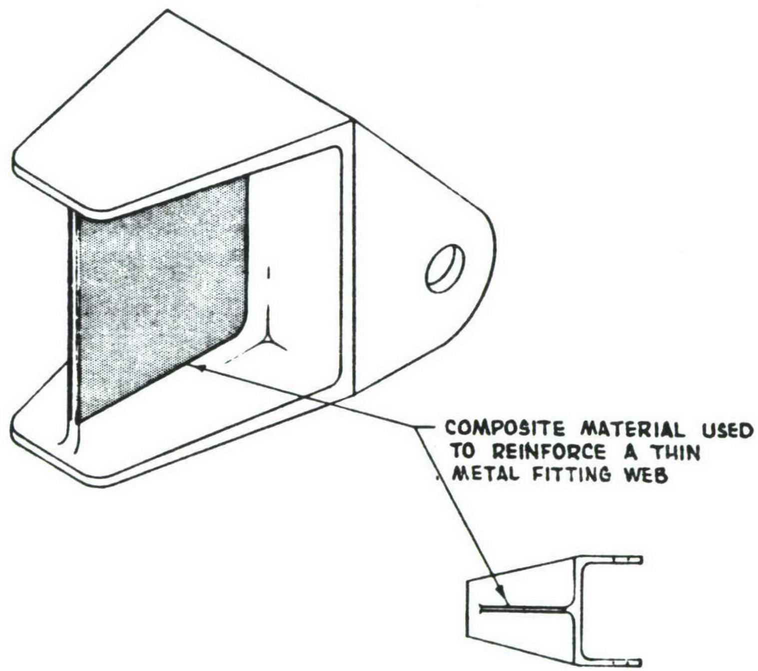
MATERIALS
ALUMINUM, TITANIUM

LOAD RANGE

CONCEPT FEATURES
- FAIL SAFE DESIGN PROVIDED BY MULTIPLE LOAD PATH FITTINGS

PREPARED BY D. E. Bloom   DATE 6·27·72

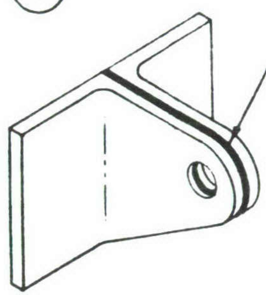
GENERAL DYNAMICS
Convair Aerospace Division
Fort Worth Operation



STRUCTURAL CONCEPT	610-702
TITLE FITTING - COMPOSITE REINFORCED	
CONCEPT DESCRIPTION FITTING DESIGNED WITH THIN WEBS WHICH ARE REINFORCED WITH ADHESIVE-BONDED PLIES OF COMPOSITE MATERIAL	
APPLICATION LOAD CARRYING FITTINGS	
MATERIALS ALUMINUM, TITANIUM, STEEL	
LOAD RANGE	
CONCEPT FEATURES • WEIGHT REDUCTION	
PREPARED BY D. E. Bloom	DATE 6-28-72
GENERAL DYNAMICS Convair Aerospace Division Fort Worth Operation	

STRUCTURAL CONCEPT 610-703

(1)



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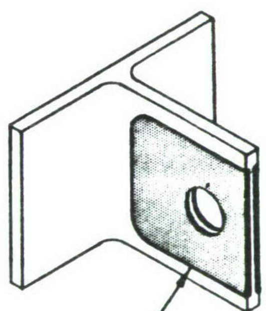


TITLE FITTING - LUG, COMPOSITE REINFORCED

CONCEPT DESCRIPTION

(1) BACK-TO-BACK FITTINGS JOINED WITH A LAYER OF COMPOSITE MATL. BETWEEN LUGS

(2) COMPOSITE MATL. "SCABBED ON" LUG AREA

APPLICATION LOAD CARRYING FITTINGS

MATERIALS ALUMINUM, TITANIUM, STEEL

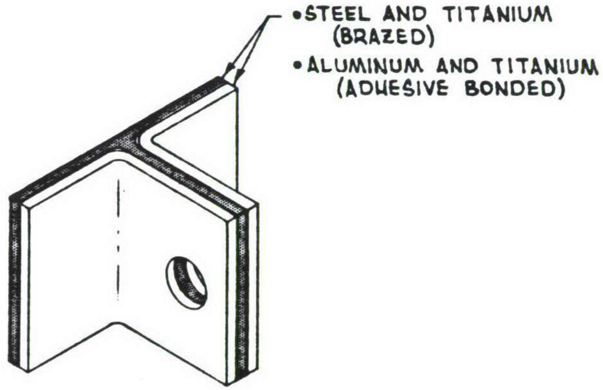
LOAD RANGE

CONCEPT FEATURES

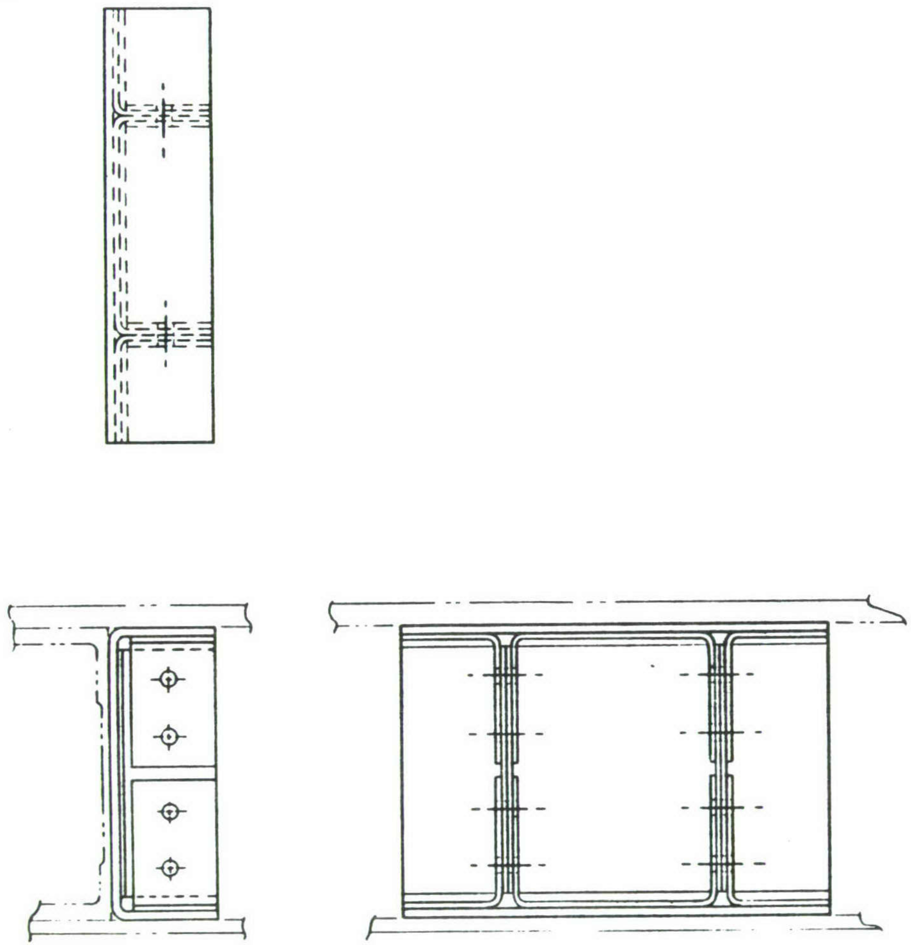
- WEIGHT REDUCTION THROUGH THE ADDED RIGIDITY PROVIDED BY THE COMPOSITE MATERIAL
- CONCEPT (1) IS A FAIL SAFE DESIGN

PREPARED BY J. E. Bloom DATE 6·28·72

GENERAL DYNAMICS
Convair Aerospace Division
Fort Worth Operation



STRUCTURAL CONCEPT	610-704
TITLE FITTING- BI-METAL	
CONCEPT DESCRIPTION FITTINGS ARE MADE BY JOINING DIFFERENT METALS TOGETHER	
APPLICATION LOAD CARRYING FITTINGS	
MATERIALS STEEL & TITANIUM (BRAZED) ALUMINUM & TITANIUM (BONDED)	
LOAD RANGE	
CONCEPT FEATURES • PERMITS UTILIZATION OF THE ATTRACTIVE PROPERTIES OF EACH MATERIAL	
PREPARED BY J. E. Bloom	DATE 6·29·72
GENERAL DYNAMICS Convair Aerospace Division Fort Worth Operation	



STRUCTURAL CONCEPT 610-705

TITLE FITTING, LAMINATED, SHEAR REACTION

CONCEPT DESCRIPTION ~ FLAT SHEET BLANKED AND FORMED. PIECES JOINED BY BONDING OR BRAZING

APPLICATION
FITTING

MATERIALS ~ BRAZED STEEL OR TITANIUM
ADHESIVE BONDED ALUMINUM OR TITANIUM

LOAD RANGE

CONCEPT FEATURES

ADVANTAGES ~
1. FAIL SAFE DESIGN
2. LOAD REACTED IN SHEAR

DISADVANTAGES ~
1. DIFFICULT TO MATCH TO CONTOUR
2. MANUFACTURING DIFFICULT DUE TO MISMATCH OF DETAIL CLIPS.

PREPARED BY J. D. Bixler DATE 7/20/72

GENERAL DYNAMICS
Convair Aerospace Division
Fort Worth Operation

APPENDIX II

CROSS SECTION DRAWINGS

II.1 SUMMARY

During the second step of the Concept Formulation Phase, fifty-one (51) cross-section drawings were completed plus two (2) baseline drawings at C.S.S. 140.0 and C.S.S. 340.0. These cross-section concepts were based on element concepts generated during the first step of this Phase. The element concepts are described in Appendix I; Phase Summary, Element Concept Sketches.

Evaluation of these fifty-three (53) cross-section drawings was based on a numerical Rating System. Details of the rating system and description of how the numerical values were generated are discussed in this report. A summary of the evaluations is shown in Table IX and Table XI.

II.2 EVALUATION AND RANKING OF CONCEPTS

An important part of the design methodology being used in this program is the evaluation and ranking of design concepts via a formal rating system. The objective of the rating system is to minimize personnel opinion and to ensure that each area of responsibility has an opportunity to influence the design configuration chosen for the production effort.

The rating system, and its use in evaluating and ranking the cross-section drawings evolved during the second portion of the Concept Formulation phase of the design approach are discussed in this report.

II.2.1 Discussion of the Rating System

The basic elements of the Rating System are shown in Table IX. The approach used to implement this system is discussed in the following paragraphs.

II.2.1.1 Structural Efficiency (30%)

Two parameters are used to evaluate the structural efficiency of a concept; cost and weight. Both received equal weight in the evaluation. Use of these parameters is discussed below:

Cost - Cost was computed for a 1.0 inch span of a wing cross-section of each concept by estimating and

Table IX

RATING SYSTEM FOR THE CROSS-SECTION DRAWINGS**
ADVANCED AIR SUPERIORITY FIGHTER WING STRUCTURES PROGRAM

STRUCTURAL* EFFICIENCY = 0.3	TECHNOLOGY ADVANCEMENT = .03	INTEGRITY & RELIABILITY = 0.3	ABILITIES = 0.1
COST = 0.5	CONCEPTS = 0.3	STATIC = 0.1	INSPECTABILITY = 0.5
WEIGHT = 0.5	MANUFACTURING = 0.3	FATIGUE = 0.3	MANUFACTURABILITY = 0.2
	MATERIALS = 0.3	SAFE CRACK = 0.2	MAINTAINABILITY = 0.1
	FRACTURE = 0.1	MULTIPLE LOAD PATH = 0.4	REPAIRABILITY = 0.1
			PREDICTABILITY = 0.1

*SERVICE LIFE WILL BE MAINTAINED AT 4000 FLIGHT HOURS. ANY DESIGN NOT MAINTAINING THIS LIFE WILL BE CONSIDERED UNACCEPTABLE.

**REVISED RATING SYSTEM 11/10/72

Table X CROSS-SECTION CONCEPTS C.S.S. 140.0 EVALUATION SUMMARY (REVISED RATING SYSTEM 11-10-72)

CONFIG NUMBER	CONFIGURATION DESCRIPTION	STRUCTURAL EFF. WEIGHT (.15)	STRUCTURAL EFF. COST IN $/IN (.15)	TECHNOLOGY ADVANCE (.30)	STRUCTURAL INTEGRITY (.30)	ABILITIES (.10)	TOTAL SCORE	RANK	REMARKS
610R000	F-111F WING BOX CROSS-SECTION CUT @ C.S.S. 140.0 (BASELINE)	(7.14) 8.01 S.C. .074	$50.29 .096	.027	.111	.094	.402	30	BASELINE
610R001	WING SECTION WELDED SPARS, CONSTANT DEPTH SAND UPPER SKIN - LAMINATED LOWER SKIN (140.0)		OBSOLETE	REITERATED UPPER SKIN ON 610R028 & LOWER SKIN ON 610R013A					OUT
610R002	WING SECTION INTEGRALLY FORMED SPARS, STIFFENED UPPER SKIN, LAM. LOWER SKIN WITH HAT STIFFENERS	(3.962) 3.962 F.S. .149	164.95 .029	.239	.217	.060	.694	3	COMBINE WITH 610R022 -1
610R003	WING SECTION WELDED SPARS, SQ. TUBE UPPER SKIN PLANK LOWER SKIN	(7.09) 7 09 F.S. .083	141.92 .034	.144	.168	.069	.498	24	OUT
610R004	WING SECTION SANDWICH SPARS SIMPL. SAND UPPER SKIN, LAMINATED STIFFENED LOWER PANEL	F.S.	OBSOLETE	REITERATED UPPER SKIN ON 610R028 & LOWER SKIN ON 610R013A					OUT
610R005	WING SECTION LAMINATED SPARS, WELDED UPPER SKIN, ADH. BOND. SAND. LOWER SKIN	F.S.	OBSOLETE	REITERATED UPPER SKIN ON 610R017A & LOWER SKIN ON 610R027					OUT
610R006	WING SECTION BRAZED LOWER SKIN WITH CRACK STOPPERS - ADH. BONDED UPPER SKIN	F.S.	OBSOLETE	REITERATED UPPER SKIN ON 610R019 & LOWER SKIN ON 610R018 - (MANUFACTURABILITY POOR)					OUT
610R007	WING SECTION FULL DEPTH LARGE CELL CORE BRAZED TO UPPER & LOWER SKIN	(4.740) 5.70 S.C. .104	211.96 .023	.217	.140	.026	.510	22	OUT
610R008	WING SECTION WELDED UPPER SKIN, PLAIN LOWER SKIN, WELD'D TRUSSES (ALL TI)		OBSOLETE	REITERATED UPPER SKIN ON 610R021 & LOWER SKIN ON 610R018. SPAR DESIGN RETAINED ON 610R015A					OUT
610R009	WING SECTION BONDED BULB STIFFENED UPPER SKIN, MACHINED/BRAZED SAND LOWER SKIN	(4.374) 4.374 F.S. .135	240.15 .020	.239	.202	.047	.643	9	OUT - EXCES-SIVE COST
610R010	WING SECTION ADH. BONDED TI SANDWICH SKINS, LOWER SKIN WITH COMPOSITE SLUGS	(4.72) 4.72 F.S. .125	204.89 .024	.189	.144	.053	.535	20	OUT
610R011	WING SECTION ADHESIVE BONDED SANDWICH UPPER/LOWER SKINS & INTERNAL SPARS	(4.27) 4.27 F.S. .139	129.82 .037	.141	.175	.068	.560	17	OUT
610R012	WING SECTION ADH. BONDED UPPER PANEL, BRAZED LOWER PANEL WITH PRESS. WRAPPED INNER SKINS		DISCONTINUED	REASON: SKIN DESIGN NOT EFFICIENT FOR REACTING INTERNAL PRESSURE					OUT

Table X (Cont'd) CROSS-SECTION CONCEPTS C.S.S. 140.0 EVALUATION SUMMARY (REVISED RATING SYSTEM 11-10-72)

CONFIG NUMBER	CONFIGURATION DESCRIPTION	STRUCTURAL EFF. WEIGHT (.15)	STRUCTURAL EFF. COST IN $/IN (.15)	TECHNOLOGY ADVANCE (.30)	STRUCTURAL INTEGRITY (.30)	ABILITIES (.10)	TOTAL SCORE	RANK	REMARKS
610R013"A"	WING SECTION LAMINATED LOWER SKIN, STEPPED SPAR CAPS - HAT STIFF. UPPER SKIN	(5.48) 5.48 F.S. .108	54.45 .088	.167	.250	.072	.685	4	A/A
610R014	WING SECTION FULL DEPTH SAND WITH HEX. CELL CORE; FOUR SIDES CORRUGATED	(4.016) 4.016 F.S. .147	233.69 .021	.276	.175	.031	.650	8	A/A
610R015"A"	WING SECTION WELDED SPACE TRUSS SUB-STRUCT - BRAZE ON SKINS	(3.99) 4.31 F.S. .137	118.29 .041	.138	.211	.034	.561	16	A/A LOW COST LOW WT 6AL-4V ANN TI
610R016	WING SECT. ALUM. INTEGRALLY STIFFENED SKIN PANELS MACHINED	(5.61) 5.69 S.C. .104	38.83 .124	.092	.148	.088	.556	18	A/A - LOW COST DES.
610R017	WING SECT. RECTANGULAR TUBE TRUSS CORE SAND PANEL, WELDED (6AL-4V TI) LOWER	(4.484) 4.91 S.C. .120	192.70 .025	.138	.155	.054	.492	26	OUT
610R018	WING SECT. WELDED Y-TEE STIFFENED SKINS	(4.044) 5.154 S.C. .114	195.11 .025	.135	.136	.057	.467	29	OUT
610R019 -1	WING SECT. INTEGRAL FORMED BULBED TEE	(4.030) 4.030 F.S. .146	126.35 .038	.183	.175	.048	.590	13	A/A
610R020	WING SECTION SANDWICH WITH TRUSS MEMBER CORE	(4.264) 4.80 S.C. .123	157.58 .031	.146	.156	.056	.512	21	OUT
610R021 -1	WING SECTION DIFFUSION BONDED/TEE STIFFENED PANELS	(4.024) 5.13 S.C. .115	159.43 .030	.130	.138	.060	.473	28	OUT
610R022 -1	WING SECT. ADH. BOND. LAM. SKINS WITH HAT STIFFENERS	(4.624) 4.624 F.S. .128	115.83 .042	.147	.236	.063	.616	11	COMBINE WITH 022-2
610R023 -1	WING SECT. MONOLITHIC/WELDED STIFF'R, INTEGRAL SPAR CAPS (6AL 4V ANN)	(4.65) 5.08 S.C. .116	95.58 .050	.117	.156	.063	.502	23	A/A LOW COST TI DES.
-2	(6AL-4V STA & 8.8.2.3 TI)	(4.17) 5.27 S.C. .112	96.06 .050	.126	.136	.063	.487	27	OUT
610R024	WING SECTION BRAZED SANDWICH SKINS WITH TRUSS MEMBER CORE	(3.94) 3.94 F.S. .150	150.12 .032	.278	.185	.060	.705	2	A/A

Table X (Cont'd) CROSS-SECTION CONCEPTS C.S.S. 140.0 EVALUATION SUMMARY (REVISED RATING SYSTEM 11-10-72)

CONFIG NUMBER	CONFIGURATION DESCRIPTION	STRUCTURAL EFF. WEIGHT (.15)	STRUCTURAL EFF. COST IN $/IN (.15)	TECHNOLOGY ADVANCE (.30)	STRUCTURAL INTEGRITY (.30)	ABILITIES (.10)	TOTAL SCORE	RANK	REMARKS
610R019 -2	WING SECTION INTEGRAL FORMED BULBED TEE (7050 AL)	(5.89) 5.89 F.S. .100	68.44 .070	.150	.170	.050	.540	19	OUT
610R021 -2	WING SECTION DIFFUSION BONDED TEE STIFFENED PANEL	(4.644) 5.17 S.C. .114	156.38 .031	.130	.159	.060	.494	25	OUT
610R022 -2	WING SECT ADH. BONDED LAM. SKINS WITH HAT STIFFENERS	(4.04) 4.04 F.S. .146	115.74 .042	.183	.217	.063	.651	7	A/A-
610R025	WING SECTION ADH. BONDED HAT STIFFENERS (7050 AL)	(5.66) 5.66 F.S. .104	32.15 .150	.135	.212	.076	.677	5	A/A
610R026	WING SECTION MODIFIED TRIANGLE CORE (7050 AL)	(5.70) 5.70 F.S. .104	38.25 .126	.137	.196	.062	.625	10	A/A
610R027	WING SECTION HONEYCOMB SANDWICH PANEL - SPARS INTGR'L WITH LOWER PANEL (TI)	(4.25) 4.25 F.S. .139	109.54 .044	.146	.191	.069	.589	14	A/A
610R028	WING SECTION AL HONEYCOMB PANEL UPPER & LOWER - INT. SPAR CAPS ADH. BONDED	(5.64) 5.64 F.S. .105	59.84 .081	.158	.184	.070	.598	12	A/A
610R029	WING SECTION LAMINATED LOWER SKIN WITH STEPPED SPAR CAPS; PLATE UPPER SKIN, CORRUGATED SPAR CAPS	(5.84) 5.84 F.S. .101	44.82 .108	.179	.250	.070	.708	1	A/A
610R030	WING SECTION ADH. BONDED CORRUGATED STIFFENER INNER SKIN C.S.S. 140.0	(5.86) 5.86 F.S. .101	49.45 .098	.138	.172	.065	.574	15	OUT
610R031	WING SECT. AL HONEYCOMB SAND. UPPER PANEL - TI, BLADE STIFFENED PLANK LOWER	(4.82) 4.82 F.S. .123	91.96 .052	.227	.191	.058	.651	6	A/A

Table XI CROSS-SECTION CONCEPTS C.S.S. 340.0 EVALUATION SUMMARY (REVISED RATING SYSTEM 11-10-72)

CONFIG. NUMBER	CONFIGURATION DESCRIPTION	STRUCTURAL EFF. WEIGHT (.15)	STRUCTURAL EFF. COST IN $/IN. (.15)	TECHNOLOGY ADVANCE (.30)	STRUCTURAL INTEGRITY (.30)	ABILITIES (.10)	TOTAL SCORE	RANK	REMARKS
610R104	F-111F WING BOX CROSS SECT. CUT @ C.S.S. 340.0 (BASELINE)	1.295 .058	34.72 .099	.053	.221	.095	.526	11	BASELINE
610R100	WING SECTION ADHESIVE BONDED SAND. LOWER SKIN & SPARS - TRUSS CORE SAND. UPPER SKIN	1.105 .068	44.14 .078	.153	.098	.054	.451	21	OUT
610R101"B"	WING SECTION FULL DEPTH LARGE CELL CORE BRAZED TO UPPER & LOWER SKINS (C.S.S. 340.0)	.580 .129	106.75 .032	.246	.092	.022	.521	12	OUT
610R102	WING SECTION ADH. BONDED CLOSE SPAR SPACING	.624 .120	41.74 .083	.182	.168	.026	.579	3	A/A
610R103	WING SECTION BONDED TI SAND. UPPER PANEL BOND. TI SAND. LOWER PANEL	1.059 .071	81.83 .042	.212	.138	.038	.501	16	OUT
610R105	WING SECTION ADH. BOND. LOWER SKINS PRESS. REACTED	.990 .076	51.97 .066	.177	.142	.055	.516	14	OUT
610R106	WING SECTION BRAZED TI SAND LOWER SKIN/WAFFLE GRID AL UPPER SKIN	- DISCONTINUED WILL NOT EFFICIENTLY REACT INTERNAL PRESS.							OUT
610R107	WING SECTION TI SAND SKINS WITH "RIBBON CANDY" FUEL FLOW PROVS.	1.119 .067	73.70 .047	.249	.123	.047	.553	8	RETAIN FUEL FLOW FEATURE ONLY
610R108	WING SECTION FULL DEPTH SANDWICH WITH HEX. CELL CORE, FOUR SIDE COR - (C.S.S. 340.0)	.706 .106	90.46 .038	.241	.144	.029	.558	5	A/A
610R109	WING SECTION MULTIPLE TENSION STRAP WELDED STIFFENER PRESS. CARRYING STRUCT.	.882 .085	54.50 .063	.107	.200	.077	.532	10	A/A
610R110	WING SECTION WELDED/ADH. BONDED TRUSS CORE PANELS	.815 .092	96.12 .036	.097	.240	.052	.517	13	OUT
610R111	WING SECTION RECT. TUBE PANELS INTEGRAL SPAR CAPS	.71 .105	87.62 .039	.148	.188	.052	.532	9	A/A
610R112	WING SECTION INTEGRAL BLADE STIFFENED ALUMINUM (C.S.S. 340.0)	.658 .114	23.43 .146	.064	.077	.090	.491	17	OUT
610R113	WING SECTION WELDED BLADE STIFFENED TITANIUM (C.S.S. 340.0)	.717 .104	63.60 .054	.091	.151	.068	.468	20	OUT
610R114	WING SECTION BRAZED TITANIUM TRUSS CORE PANELS INTEGRAL SPAR CAPS	.855 .098	63.72 .054	.190	.089	.053	.484	18	OUT

Table XI (Cont'd) CROSS-SECTION CONCEPTS C.S.S. 340.0 EVALUATION SUMMARY (REVISED RATING SYSTEM 11-10-72)

CONFIG. NUMBER	CONFIGURATION DESCRIPTION	STRUCTURAL EFF. WEIGHT (.15)	STRUCTURAL EFF. COST IN $/IN. (.15)	TECHNOLOGY ADVANCE (.30)	STRUCTURAL INTEGRITY (.30)	ABILITIES (.10)	TOTAL SCORE	RANK	REMARKS
610R115 -1	WING SECTION INTEGRAL TEE STIFFENED SKINS (C.S.S. 340.0) (ALUMINUM)	.524 .143	47.12 .073	.107	.083	.077	.483	19	OUT
610R115 -2	WING SECTION INTEGRAL TEE STIFFENED SKINS (C.S.S. 340.0)	.652 .115	148.11 .023	.115	.182	.067	.502	15	OUT
610R116	WING SECTION ADH. BONDED, CORRUGATED STIFFENER INNER SKIN (C.S.S. 340.0)	.636 .118	28.43 .021	.121	.103	.070	.533	7	A/A
610R117	WING SECTION SANDWICH SKIN PANELS INTEGRAL LOWER SPAR CAPS	.498 .150	34.69 .099	.158	.123	.062	.592	2	A/A
610R118	WING SECTION MODIFIED TRIANGULAR CORE - ADH. BONDED AL.	.820 .091	28.26 .122	.155	.120	.059	.547	6	A/A
610R119	WING SECTION ADH. BONDED HAT STIFFENER; 7050 AL	.65 .115	22.87 .150	.151	.164	.081	.661	1	A/A
610R120	WING SECTION INTEGRAL FORMED BULB TEE	.66 .113	49.49 .070	.164	.162	.062	.571	4	A/A

summing the material cost, the tooling cost and the fabrication and assembly cost. Cost data was developed by Value Engineering using inputs from Industrial Engineering and Materials Estimating Department. The cost score recorded in the Concept Evaluation Summary is:

$$\text{Cost Score} = \frac{\text{Cost of lowest cost concept}}{\text{Cost of concept (being scored)}} \text{ X } (.15)$$

This results in the lowest cost concept having a maximum weighted score of .15.

<u>Weight</u> - Weight was computed for a 1.0 inch span of a wing cross-section of each concept which had been sized to the controlling criteria of either critical static loads, fatigue or damage tolerance criteria. The weight score recorded in the Concept Evaluation Summary is:

$$\text{Weight Score} = \frac{\text{Weight of lightest concept}}{\text{Weight of concept being scored}} \text{ X}.15$$

This results in the lightest concept having a maximum weighted score of .15.

II.2.1.2 <u>Technology Advancement (30%)</u>

The weighted technology advancement score is made up of the sum of weighted scores from Concepts, Manufacturing Technology, Materials Technology and Fracture Technology. The weighted scores for each of the four technology advancement parameters is defined below:

<u>Concept Technology</u>

The weighted concept technology score was computed for each concept by counting the number of innovations embodied in each concept and rationing the scores such that the highest ranking score equals .09. An example of the work sheet for computing Concept Technology Advancement Score is shown in Figure 1.

Concept No.	Innovative Features	No. of Features	% Score	Weighted Score
610R014	1. Full depth "wet" cell core concept. 2. Elimination of lower skin fasteners. 3. Large cell core concept. 4. Laminated lower skin. 5. Planked lower skin. 6. Core corrugation des.	6	100	.09
610R018	1. Welded Y-tee skin panel design 2. Elimination of lower skin fasteners	2	33	.03

Figure 1 Concept Technology Advancement Sample Score Sheet

Manufacturing Technology

The weighted score for manufacturing technology is computed by scoring the concept from 0% to 100% on the degree to which it will advance manufacturing technology and multiplying the percent value by .09. The work sheets used to arrive at these evaluations are shown in Appendix A.

Material Technology

The weighted score for material technology was determined as follows:

a. Determine the number of new materials such as 8-8-2-3 titanium and new processes such as low temp braze in each concept.

b. Assign a percent score of 100 to the highest scored concepts.

c. Multiply the percent score of each concept by .09.

Fracture Mechanics Technology

The weighted score for fracture technology is based on the degree to which fracture mechanics technology would be advanced if the concept being evaluated is pursued to operational hardware status. The lower surface wing structure only is

considered. The example of Fracture Technology Work Sheet shown in Figure 2 below shows how the weighted score was computed.

Concept No.	Plain Stress (20)	Complex Stress Field (20)	Load Shedding (20)	Crack Arrest (20)	Matl Devel. Req'd (20)	Percent Score	Weighted Score (.03)
610R000	X	20	X	X	20	40	.012
610R002	20	X	20	20	20	80	.024
610R010	20	20	20	20	20	100	.030

Figure 2 Fracture Mechanics Technology Advancement Sample Score Sheet

II.2.1.3 Structural Integrity

The structural parameters assessed during this portion of the rating system were static strength, fatigue quality, safe crack growth, and fail safe characteristics.

Static Strength

The "static" integrity & reliability is based on static margin. Thus, a structure that is sized by fatigue or crack propagation criteria will have excess static strength. The degree of excess static strength is the ratio of static strength available to static strength required. If the structure is critical for static loads this ratio is unity. In comparing the many candidate concepts the first step is to calculate the static strength ratio for each concept. The next step is to normalize all values based on that concept which shows the highest static strength ratio. A final weighted value is then determined for each concept by multiplying its normalized static strength ratio by .03 (since .30 x .10 = .03).

Fatigue Quality

To compare the fatigue quality characteristics of the various design concepts the ratio, C_F, is first calculated for each concept where:

$$C_F = \frac{\sigma_F}{\sigma_S}$$

σ_F = maximum allowable stress based on fatigue considerations

σ_S = maximum static stress in the wing cross-section

The allowable fatigue stress reflects the F-111F service loads spectrum, the type of material and the maximum stress concentration factor, K_T. Since the wing bending loads at wing center spar station 140 are substantial, the maximum static stress in the wing cross-section corresponds to the material tension ultimate. To facilitate the rapid determination of C_F for each concept a plot of C_F versus K_T has been constructed as shown in Figure 3 for the materials being considered for the wing lower surface. It can be seen that the maximum value of C_F ($C_F = 1.63$) occurs in designs utilizing annealed 6AL-4V titanium without stress concentrations ($K_T = 1.0$). C_F for each concept is then normalized on the basis of the maximum value of C_F resulting in values of $C_F' = \frac{C_F}{1.63}$.

The preceeding paragraph describes the manner in which the apparent stress concentrations (K_T) in each design concept has been accounted for in the fatigue quality comparisons. However, in addition to the apparent stress concentrations certain designs have sources of potential stress concentrations which might very well exceed the apparent K_T values. For example, lower surface holes with a readily assignable $K_T = 3.4$ (for carefully prepared tapered fasteners) were considered to be sources of potential additional stress concentration because of possible sharp scratches during bolt installation. In addition, chordwise changes of thickness were considered to be potential sources of stress concentration due to machining defects that might occur. Spanwise welds were also considered in a similar fashion. A count of all such sources of potential K_T increases was conducted for each design concept and a two

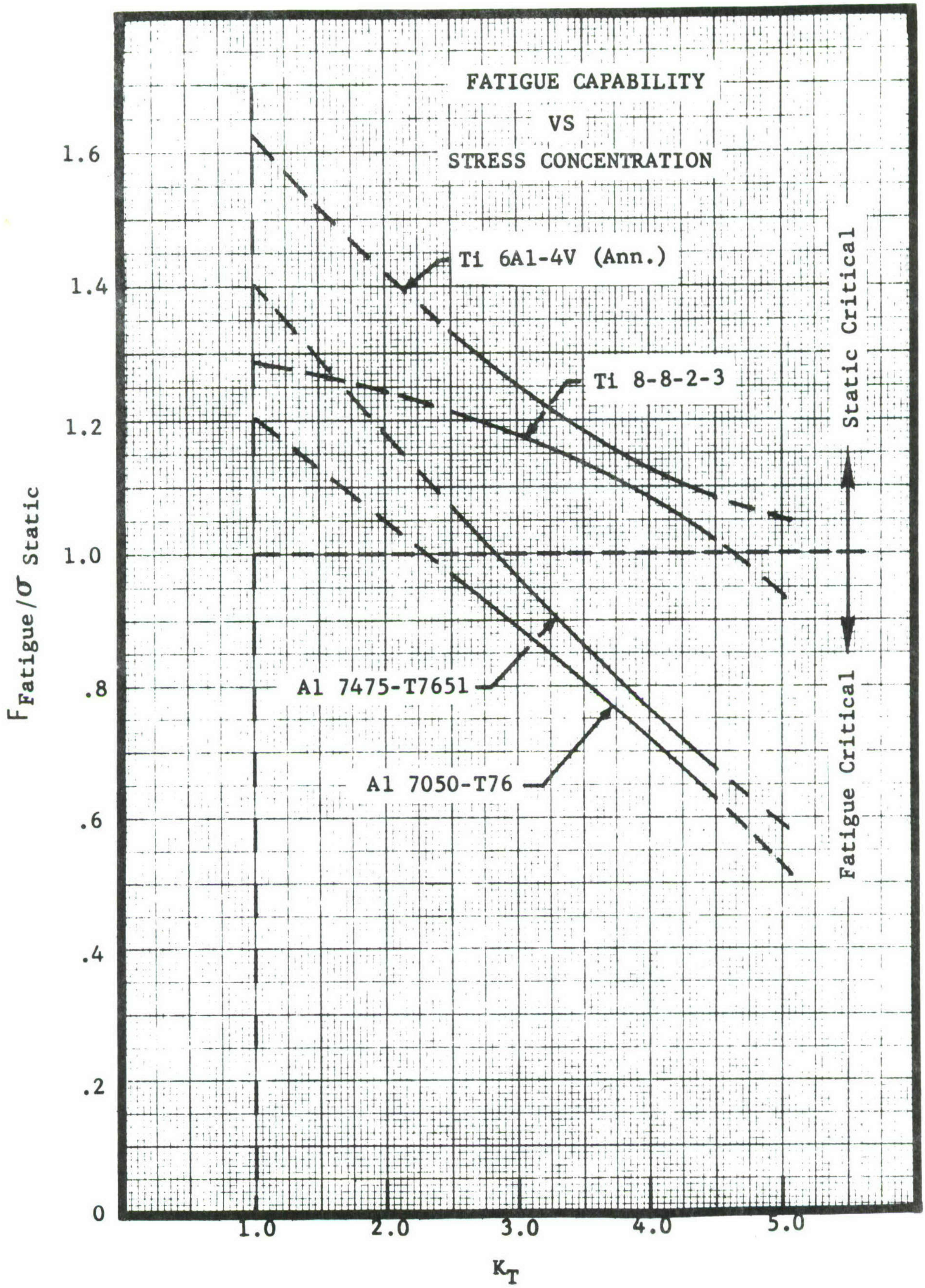


Figure 3 - Fatigue Capability vs Stress Concentration

percent reduction in C_F' was taken for each possible source of trouble. The relative fatigue rating for each concept is then expressed as follows:

$$R = \frac{C_F}{1.63} - .02n \quad \text{Where: } n = \text{number of potential defects}$$

The final weighed value of fatigue quality for each concept was then obtained by multiplying R by .09 (.30 x .30).

Safe Crack

"Safe crack" is interpreted as referring to the maximum stress in the fatigue stress spectrum consistent with stable crack growth. Each design concept is analyzed for cracks starting at both surface flaws and at holes (unless the concept is free of holes). There are four damage tolerance categories:

FS	=	fail-safe, hole-free structure
FSH	=	fail-safe structure with holes
SCG	=	slow crack growth (not fail-safe) structure
SCGH	=	slow crack growth structure with holes

The critical crack growth stress level, F_{cr}, is controlled by the damage tolerance category and the type of material in accordance with MIL-STD-1530. The ratio of the critical crack growth stress to the maximum static tension stress is considered a measure of excess damage tolerance capability. The ratios are then divided by the maximum such ratio and multiplied by .06 (.30 x .20) to obtain the final weighted values.

Multiple Load Path

The "Multiple Load Path" category is considered synonymous with fail-safe capability. For each cross-section design concept, a count has been made of the maximum number of individual structural elements that could be failed without impairing load capability. By dividing all such counts by the highest (nine), all values are converted to a unit scale. The weighted values are then obtained by multiplying the normalized counts by .12 (.4 x .3).

II.2.1.4 Abilities

The weighted "abilities" socre is made up of the sum of weighted scores from inspectability, manufacturability, maintainability, repairability, and predictability. Each "ability" for each concept was first scored on a percentage basis from o to 100%. The percentage scores were then multiplied by the appropriate weighting factor specified in Table IX.

II.2.2 Evaluation of Concept

During the Cross-Section portion of the Concept Formulation Phase of this program, fifty-one (51) new cross-section drawings and two (2) baseline cross-section drawings were prepared. These are included in Section II.3 for reference. Evaluation of these is discussed below and is summarized in Tables X and XI.

II.2.2.1 Structural Efficiency

Evaluation of weight and cost are included in Tables X and XI for each cross-section drawing. The weight based on static strength is shown in parenthesis in the upper left hand corner of the "weight" block. The final weight is shown in the upper right hand corner. In the lower left hand corner is the damage tolerance category of the concept. The initials are discussed in paragraph II.2.1.3 above.

In the "cost" block of each concept is the dollar value of a one inch span os a wing cross-section prepared by Value Engineering. Also shown is the score for that cost.

II.2.2.2 Technology Advancement

To assist in the evaluation of Technology Advancement, a chart was prepared to record the results in each area. The charts for C.S.S. 140 concepts is shown in Table XII and C.S.S. 340 concepts in Table XIII. The total score is shown in the Evaluation Summary, Table X and XI.

II.2.2.3 Structural Integrity

Charts were also prepared to organize the results of this evaluation. Table XIV is the chart for C.S.S. 140 concepts, while Table XV is for C.S.S. 340 concepts. Again, the total score is shown in Table X and XI.

II.2.2.4 Abilities

The charts for collecting the results of evaluation of "Abilities" are shown in Table XVI and Table XVII, with the totals tabulated in Table X and XI. Since "Inspectability" accounted for one-half of the rating, a separate chart was prepared by the NDI specialists on the program. This insured that both production inspection and field level inspection was considered.

All of the cross-section concepts were re-evaluated to assign a finite inspectability rating for each structure. The ratings were determined by comparing the inspectability of each design configuration with the relative inspectability of the baseline configuration.

Each configuration has been given three ratings; a manufacturing inspectability, a field inspectability and an overall inspectability. The manufacturing inspectability rating defines the relative inspectability of each concept in the factory during fabrication. The field inspectability rating is a measure of the efficiency of inspecting the assemblies after installation in the aircraft. The overall rating is a weighted average of the other two. The three ratings are necessary to explain the differences in inspectability at each stage in the fabrication and life of the assembly. The results of this study are shown in Table XVIII.

Table XII

CROSS SECTION CONCEPTS

EVALUATION WORK SHEET

C. Spar Sta: 140.0

Concept No.	TECHNOLOGY ADVANCEMENT (.30) Concept Tech. Advance (.09)	Manufact Tech. Advance (.09)	Materials Tech. Advance (.09)	Fract Mech (.03) Tech Advance	TOTAL (.30)
610R000 Baseline	16.7 .015	0 0	0 0	40 .012	.027
610R001	OBSOLETE - REITERATED				
610R002	100 .090	79 .071	60 .054	80 .024	.239
610R003	50 .045	63 .057	20 .018	80 .024	.144
610R004	OBSOLETE - REITERATED				
610R005	OBSOLETE - REITERATED				
610R006	OBSOLETE - REITERATED				
610R007	66.7 .061	100 .09	60 .054	40 .012	.217
610R008	OBSOLETE - REITERATED				
610R009	66.7 .061	91 .082	80 .072	80 .024	.239
610R010	50 .045	67 .060	60 .054	100 .030	.189
610R011	50 .045	33 .030	40 .036	100 .030	.141
610R012	DISCONTINUED				
610R013	83.3 .075	29 .026	40 .036	100 .030	.167
610R014	100 .090	100 .09	80 .072	80 .024	.276
610R015	50 .045	50 .045	20 .018	100 .030	.138

Table XII (CONT'D)

CROSS SECTION CONCEPTS

EVALUATION WORK SHEET

C. Spar Sta: 140.0

Concept No	TECHNOLOGY ADVANCEMENT (.30) Concept Tech. Advance (.09)	Manufact Tech. Advance (.09)	Materials Tech. Advance (.09)	Fract Mech (.03) Tech Advance	TOTAL (.30)
610R016	16.7 .015	25 .023	40 .036	60 .018	.092
610R017	66.7 .060	67 .060	0 0	60 .018	.138
610R018	33.3 .030	83 .075	20 .018	40 .012	.135
610R019 -1	50 .045	67 .060	60 .054	80 .024	.183
610R019 -2	50 .045	50 .045	40 .036	80 .024	.150
610R020	50 .045	92 .083	0 0	60 .018	.146
610R021-1 -2	33 .030 33 .030	71 .064 71 .064	20 .018 20 .018	60 .018 60 .018	.130 .130
610R022 -1	66.7 .060	50 .045	20 .018	80 .024	.147
610R022 -2	66.7 .060	50 .045	60 .054	80 .024	.183
610R023 -1	50 .045	67 .060	0 0	40 .012	.117
610R023 -2	50 .045	67 .060	10 .009	40 .012	.126
610R024	83.3 .075	92 .083	100 .09	100 .030	.278
610R025	50 .045	33 .030	40 .036	80 .024	.135
610R026	50 .045	29 .026	40 .036	100 .030	.137
610R027	50 .045	25 .023	60 .054	80 .024	.146
610R028	83.3 .075	25 .023	40 .036	80 .024	.158

Table XII (CONT'D)

CROSS SECTION CONCEPTS

EVALUATION WORK SHEET

C. Spar Sta:

Concept No.	TECHNOLOGY ADVANCEMENT (.30)				TOTAL (.30)
	Concept Tech. Advance (.09)	Manufact Tech. Advance (.09)	Materials Tech. Advance (.09)	Fract Mech (.03) Tech Advance	
610R029	83.3 .075	42 .038	40 .036	100 .03	.179
610R030	50 .045	37 .033	40 .036	80 .024	.138
610R031	83.3 .075	62 .056	80 .072	80 .024	.227

Table XIII

CROSS SECTION CONCEPTS

EVALUATION WORK SHEET

C. Spar Sta: 340.0

Concept No.	TECHNOLOGY ADVANCEMENT (.30)				TOTAL (.30)
	Concept Tech. Advance (.09)	Manufact Tech. Advance (.09)	Materials Tech. (.09) Advance	Fract Mech (.03) Tech Advance	
610R100	.072	.034	.023	.024	.153
610R101	.054	.090	.090	.012	.246
610R102	.090	.045	.023	.024	.182
610R103	.072	.071	.045	.024	.212
610R104 BASELINE	.018	.023	0	.012	.053
610R105	.072	.030	.045	.030	.177
610R106	OUT				
610R107	.090	.045	.090	.024	.249
610R108	.072	.090	.067	.012	.241
610R109	.036	.030	.023	.018	.107
610R110	.036	.008	.023	.030	.097
610R111	.054	.053	.023	.018	.148
610R112	0	.023	.023	.018	.064
610R113	.036	.037	.000	.018	.091
610R114	.054	.083	.023	.030	.190
610R115-1	.036	.030	.023	.018	.107
-2	.036	.038	.023	.018	.115
610R116	.018	.034	.045	.024	.121
610R117	.072	.023	.045	.018	.158
610R118	.054	.026	.045	.030	.155
610R119	.072	.010	.045	.024	.151
610R120	.054	.041	.045	.024	.164

Table XIV

CROSS SECTION CONCEPTS

EVALUATION WORK SHEET

C. Spar Sta: 140.0

Concept No.	Structural Integrity (.30)				
	Static (.03)	Fatigue Quality (.09)	Safe Crack Growth (.06)	Fail Safe Char. (.12)	TOTALS (.30)
610R000 Baseline	.031	.041	.026	.013	.111
610R001	OBSOLETE - REITERATED				
610R002	.018	.071	.048	.080	.217
610R003	.018	.059	.037	.054	.168
610R004	OBSOLETE - REITERATED				
610R005	OBSOLETE - REITERATED				
610R006	OBSOLETE - REITERATED				
610R007	.030	.071	.026	.013	.140
610R008	OBSOLETE - REITERATED				
610R009	.018	.069	.048	.067	.202
610R010	.018	.061	.025	.040	.144
610R011	.018	.069	.048	.040	.175
610R012	DISCONTINUED				
610R013	.018	.064	.048	.120	.250

Table XIV (CONT'D)

CROSS SECTION CONCEPTS

EVALUATION WORK SHEET

C. Spar Sta: 140.0

Concept No.	Structural Integrity (.30)				
	Static (.03)	Fatigue Quality (.09)	Safe Crack Growth (.06)	Fail Safe Char. (.12)	TOTALS (.30)
610R014	.018	.069	.048	.040	.175
610R015	.018	.066	.060	.067	.211
610R016	.019	.074	.042	.013	.148
610R017	.022	.085	.035	.013	.155
610R018	.030	.067	.026	.013	.136
610R019 -1	.018	.069	.048	.040	.175
610R020	.023	.085	.035	.013	.156
610R021 -1	.030	.069	.026	.013	.138
-2	.023	.088	.035	.013	.159
610R022 -1	.018	.090	.060	.068	.236
610R022 -2	.018	.071	.048	.080	.217
610R023 -1	.022	.086	.035	.013	.156
610R023 -2	.030	.067	.026	.013	.136
610R024	.030	.067	.048	.040	.185
610R025	.018	.066	.048	.080	.212
610R019-2	.018	.064	.048	.040	.170

Table XIV (CONT'D)

CROSS SECTION CONCEPTS

EVALUATION WORK SHEET

C. Spar Sta: 140.0

Concept No.	Structural Integrity (.30)				
	Static (.03)	Fatigue Quality (.09)	Safe Crack Growth (.06)	Fail Safe Char. (.12)	TOTALS (.30)
610R026	.018	.062	.048	.067	.196
610R027	.018	.071	.048	.054	.191
610R028	.018	.064	.048	.054	.184
610R029	.018	.064	.048	.120	.250
610R030	.023	.062	.048	.039	.172
610R031	.018	.071	.048	.054	.191

Table XV

CROSS SECTION CONCEPT

EVALUATION WORK SHEET

C. Spar Sta: 340.0

Concept No.	Structural Integrity				
	Fatigue Quality (.09)	Safe Crack Growth (.06)	Fail Safe Char. (.12)	Static (.03)	TOTALS .30
610R100	.0099	.0148	.066	.0074	.098
610R101	.0566	.0238	0	.0119	.092
610R102	.0189	.0200	.120	.009	.168
610R103	.0333	.026	.066	.0131	.138
610R104 BASELINE	.114	.063	.013	.031	.221
610R105	.0207	.0192	.0935	.009	.142
610R106	OUT				
610R107	.0342	.0150	.066	.0075	.123
610R108	.088	.0376	0	.0188	.144
610R109	.0855	.0583	.0264	.0294	.200
610R110	.0845	.060	.066	.03	.240
610R111	.0845	.060	.0132	.03	.188
610R112	.0243	.0274	.0132	.0121	.077
610R113	.0675	.0467	.0132	.0234	.151
610R114-1 -2	.0162 .0657	.0243 .0467	.0396 .0396	.00922 .0234	.089 .175
610R115-1 -2	.0252 .0830	.0257 .057	.0132 .0132	.0112 .0285	.083 .182
610R116	.0243	.0273	.0396	.0121	.103

Table XV (CONT'D)

CROSS SECTION CONCEPT

EVALUATION WORK SHEET
(CONT'D)

C. Spar Sta: 340.0

Concept No.	Structural Integrity				
	Fatigue Quality (.09)	Safe Crack Growth (.06)	Fail Safe Char. (.12)	Static (.03)	TOTALS .30
610R117	.0252	.0214	.066	.0108	.123
610R118	.0153	.0303	.066	.0082	.120
610R119	.0387	.0303	.080	.0152	.164
610R120	.0368	.0303	.080	.0152	.162

Table XVI

CROSS SECTION CONCEPTS

EVALUATION WORK SHEET

C. Spar Sta: 140.0

Concept No.	Abilities (.10)					
	Inspect. (.05)	Manuf. (.02)	Maintain. (.01)	Repair (.01)	Predict (.01)	Tot. (.10)
610R000 Baseline	.050	.020	.010	.007	.007	.094
610R001	OBSOLETE - REITERATED					
610R002	.038	.007	.005	.007	.003	.060
610R003	.036	.009	.007	.007	.010	.069
610R004	OBSOLETE - REITERATED					
610R005	OBSOLETE - REITERATED					
610R006	OBSOLETE - REITERATED					
610R07	.005	.003	.005	.005	.008	.026
610R008	OBSOLETE-REITERATED					
610R009	.025	.004	.005	.007	.006	.047
610R010	.027	.007	.007	.008	.004	.053
610R011	.038	.010	.007	.008	.005	.068
610R012	DISCONTINUED					
610R013	.039	.013	.005	.008	.007	.072
610R014	.005	.004	.007	.006	.009	.031
610R015	.020	.003	.007	.004	.000	.034

Table XVI (CONT'D)

CROSS SECTION CONCEPTS

EVALUATION WORK SHEET

C. Spar Sta: 140.0

Concept No.	Abilities (.10)					
	Inspect. (.05)	Manuf. (.02)	Maintain. (.01)	Repair (.01)	Predict. (.01)	Tot. (.10)
610R016	.046	.020	.007	.007	.008	.088
610R017	.035	.003	.005	.008	.003	.054
610R018	.034	.007	.008	.007	.001	.057
610R019 -1	.027	.004	.007	.007	.003	.048
610R019 -2	.027	.008	.005	.007	.003	.050
610R020	.030	.010	.007	.007	.002	.056
610R021-1	.035	.008	.008	.007	.002	.060
-2	.035	.008	.008	.007	.002	.060
610R022 -1	.035	.009	.005	.008	.006	.063
610R022 -2	.035	.009	.005	.008	.006	.063
610R023 -1	.035	.012	.008	.007	.001	.063
610R023 -2	.035	.012	.008	.007	.001	.063
610R024	.032	.011	.005	.007	.005	.060
610R025	.039	.017	.005	.009	.006	.076
610R026	.039	.008	.003	.007	.005	.062
610R027	.039	.010	.005	.010	.005	.069
610R028	.041	.011	.005	.008	.005	.070

Table XVI (CONT'D)

CROSS SECTION CONCEPTS

EVALUATION WORK SHEET

C. Spar Sta: 140.0

Concept No.	Abilities (.10)					
	Inspect. (.05)	Manuf. (.02)	Maintain. (.01)	Repair (.01)	Predict (.01)	Tot. (.10)
610R029	.038	.013	.005	.007	.007	.070
610R030	.040	.010	.003	.008	.004	.065
610R031	.038	.006	.005	.008	.001	.058

Table XVII

CROSS SECTION CONCEPTS

C. Spar Sta: 340.0

EVALUATION WORK SHEET

Concept No.	Abilities (.10)					
	Inspect. (.05)	Manuf. (.02)	Maintain (.01)	Repair (.01)	Predict. (.01)	TOTAL (.10)
610R100	.033	.010	.003	.006	.002	.054
610R101	.005	.001	.003	.005	.008	.022
610R102	.003	.004	.002	.008	.009	.026
610R103	.020	.004	.005	.008	.001	.038
610R104 BASELINE	.050	.020	.010	.008	.007	.095
610R105	.033	.008	.003	.006	.005	.055
610R106	OUT					
610R107	.027	.005	.005	.008	.002	.047
610R108	.005	.004	.005	.006	.009	.029
610R109	.043	.016	.005	.008	.005	.077
610R110	.035	.003	.003	.008	.003	.052
610R111	.036	.005	.003	.008	0	.052
610R112	.050	.020	.005	.008	.007	.090
610R113	.036	.013	.007	.008	.004	.068
610R114	.033	.004	.003	.008	.005	.053
610R115	.043 .043	.013 .007	.005 .005	.008 .008	.008 .004	.077 .067
610R116	.039	.013	.003	.009	.006	.070
610R117	.035	.013	.003	.010	.001	.062
610R118	.035	.008	.003	.007	.006	.059
610R119	.039	.018	.005	.009	.010	.081
610R120	.033	.011	.005	.007	.006	.062

Table XVIII

CROSS SECTION CONCEPTS
EVALUATION WORK SHEET
C.S.S. 140

DRAWING NO.	MANUFACTURING INSPECTABILITY	FIELD INSPECTABILITY	OVERALL INSPECTABILITY
610R000 Baseline	100	100	100
610R002	70	80	75
610R003	70	75	72
610R007	25	5	10
610R009	40	65	50
610R010	50	70	55
610R011	70	80	75
610R013	75	85	77
610R014	45	5	10
610R015	75	10	40
610R016	95	90	92
610R017	65	75	70
610R018	75	60	68
610R019-1	60	50	55
610R019-2	60	50	55
610R020	50	75	60
610R021	65	75	70
610R022-1	65	75	70
610R022-2	65	75	70
610R023-1	60	80	70
610R023-2	60	80	70

Table XVIII (CONT'D)

DRAWING NO.	MANUFACTURING INSPECTABILITY	FIELD INSPECTABILITY	OVERALL INSPECTABILITY
610R024	55	70	65
610R025	75	80	78
610R026	75	80	78
610R027	80	75	77
610R028	85	80	82
610R029	70	80	75
610R030	70	85	81
610R031	73	80	78
610R100	65	65	65
610R101	55	65	65
610R102	55	5	10
610R103	40	45	40
610R104 Baseline	100	100	100
610R105	65	65	65
610R106	45	70	55
610R107	50	60	55
610R108	35	5	10
610R109	85	85	85
610R110	55	80	70
610R111	70	75	72
610R112	95	95	95

Table XVIII (Cont'd)

DRAWING NO.	MANUFACTURING INSPECTABILITY	FIELD INSPECTABILITY	OVERALL INSPECTABILITY
610R113	70	75	73
610R114	60	70	65
610R115	80	90	85
610R116	75	80	78
610R117	70	70	70
610R118	65	75	70
610R119	80	75	78
610R120	55	75	65

II.2.3 Ranking of Concepts

The results of all the evaluations discussed in paragraph II.2.2 were tabulated in Tables X and XI. These results were added together to obtain the Total Score. The concept with the highest Total Score was ranked number 1 and the concept with the lowest Total Score was ranked last.

II.2.4 Utilization in Analytical Assemblies

The concepts with the highest scores were chosen for use in Analytical Assemblies, the next step in the Design Approach being used in this program. The concepts so chosen are identified in the Remarks column of Tables X and XI with an A/A for Analytical Assembly.

SECTION II.3

MANUFACTURING TECHNOLOGY

WORKSHEETS

TITLE ______ DWG. NO. 610R-002"A"

CSS 140

MATERIAL	COMPONENT	ADV. MATL.
8823 Ti S/M or 6-4 Ti	All	Yes

MFG. PROCESS	COMPONENT	ADV. METH.
Forming	All	Yes
Weld Bond (Subassy.)	Stiff.	Yes
Adh. Bond Lam	L/Skin/Spar	Yes
Adh. Bond	Skin/Stiff	No
Bolt Assy.	U/Skin & Spar	No

COMMENTS:

Forming stiffeners to a tapered condition could be a major problem. Assume stiffeners to be parallel.

CONCEPT RATING

ADVANCED TECHNOLOGY			MANUFACTURING				COST FACTOR
MFG.	MATL.	TOTAL	BASIC	SECOND	FINAL	TOTAL	TOOL: 220
		.071				.066	MFG:

TITLE ______ DWG. NO. 610R-003

CSS 140

MATERIAL	COMPONENT	ADV. MATL.
6-4 Ti	All	Yes

MFG. PROCESS	COMPONENT	ADV. METH.
Extrude (Alt.-Weld)	U. Skin Tube Sect.	Yes
Form	Skins & Spars to Contour	Yes
E.B. Weld	Spar Assys.	Yes
Adh. Bond	U. Skin Panel Assy.	Yes
Bolt Assy.	U. Skin Pan.-Spars-L. Skins	No

COMMENTS:

Bonding of square tubes should have foam adhesive between tubes to allow tube mismatch during bonding.

Spike welding (E.B.) of spar panels will require development and data for reliability.

CONCEPT RATING

ADVANCED TECHNOLOGY			MANUFACTURING				COST FACTOR
MFG.	MATL.	TOTAL	BASIC	SECOND	FINAL	TOTAL	TOOL: 215
		.057				.0093	MFG:

TITLE		DWG. NO.	610R-007
		CSS	140

MATERIAL	COMPONENT	ADV. MATL.
8823 Ti	Skins & Spars	Yes
6-4 Ti	Core	Yes
Ti Braze Alloy	Core to Skin Braze	Yes

MFG. PROCESS	COMPONENT	ADV. METH.
Form	Skins to Contour	Yes
Form, Weld & Mach.	Full Depth Core	Yes
Braze (Low Temp)	Skin, Spars, Core	Yes

COMMENTS:

Need core fabrication methods developed.

Need low temp brazing alloy developments.

Design requires large scale brazing facilities.

CONCEPT RATING

ADVANCED TECHNOLOGY			MANUFACTURING				COST FACTOR
MFG.	MATL.	TOTAL	BASIC	SECOND	FINAL	TOTAL	TOOL: 350
		.09				.0026	MFG:

TITLE ______ DWG. NO. 610R-009

CSS 140

MATERIAL	COMPONENT	ADV. MATL.
6-4 Ti	U. Skin & Stiff	Yes
8823 Ti	Spar & L. Skin & Stiff.	Yes
5052 AL	H/C Core	No
6-4 Ti	F. & R. Spars	Yes

MFG. PROCESS	COMPONENT	ADV. METH.
Form	Integ. Panel Stiff.	Yes
Form	U & L Skins to Contour	Yes
Mach.	L. Skin Panel Inner Section	No
Braze & Weld	L. Skin Panel & Spar Caps	Yes
Diffusion Mold	F & R Spar	Yes
Bolt	U. Spar Cap & U. Skin	No

COMMENTS:

Diffusion Molding needs development.

Large area brazing needs development.

Need a braze alloy, low temp. Bulb stiffeners require development.

CONCEPT RATING

ADVANCED TECHNOLOGY			MANUFACTURING				COST FACTOR
MFG.	MATL.	TOTAL	BASIC	SECOND	FINAL	TOTAL	TOOL: 500
		.0785				.004	MFG:

TITLE ______ DWG. NO. 610R-010

CSS 140

MATERIAL	COMPONENT	ADV. MATL.
8823 Ti S/M	Skins	Yes
5052 Alum	H/C Core	No
Graphite Comp	L. Spar Cap Slug	Yes

MFG. PROCESS	COMPONENT	ADV. METH.
Adh. Bond Panel	U/L Skins & Spar	No
Weld	U. Skin Panel & Spars	No
Filament Placeing	L. Spar Caps	Yes

COMMENTS:

Problem: Wide area bonding and inclusion of graphite slugs with built in fastener holes.

Assembly will require unusual tooling to C/O hole patterns in lower skin and spars.

CONCEPT RATING

ADVANCED TECHNOLOGY			MANUFACTURING				COST FACTOR
MFG.	MATL.	TOTAL	BASIC	SECOND	FINAL	TOTAL	TOOL: 180
		.06				.0066	MFG:

TITLE ______ DWG. NO. 610R-011

CSS 140

MATERIAL	COMPONENT	ADV. MATL.
8823 Ti	Skins	Yes
6-4 Ti	Spar	Yes

MFG. PROCESS	COMPONENT	ADV. METH.
Adh. Bond Panels	Skins - Spars	No
Weld	F/R Spar	Yes
Assy - Bolted	U/Skin - Spar	No

COMMENTS:

Problem is wide area bonding of spars and skin panels.

CONCEPT RATING

ADVANCED TECHNOLOGY			MANUFACTURING				COST FACTOR
MFG.	MATL.	TOTAL .03	BASIC	SECOND	FINAL	TOTAL .010	TOOL: 175 MFG:

TITLE		DWG. NO.	610R-013 "B"
		CSS	140

MATERIAL	COMPONENT	ADV. MATL.
7050-T76	Upper Skin Sand. Panel	Yes
7050-T76	Upper Spar Caps	Yes
7050-T7651	Upper Skins & Slug	Yes
7050-T76	Lower Skin Laminates	Yes
7050-T73651	Spar Web & Cap	Yes
7050-	Lower Spar Cap Doublers	Yes

MFG. PROCESS	COMPONENT	ADV. METH.
Shear & Route	L/Skin Laminates	No
Machine & Etch	Spars	No
Adh. Bond	U/S H/C Panel	No
Adh. Bond	L/Skin Laminates & Spars	Yes
Bolted	Assy - Spars & U/Skin	No

COMMENTS:

Problems in wide area bonding:

°Bonding of spar to lower skin
°Bonding of laminates.

CONCEPT RATING

ADVANCED TECHNOLOGY (.12 max)			MANUFACTURING (.02 max)				COST FACTOR
MFG.	MATL.	TOTAL	BASIC	SECOND	FINAL	TOTAL	TOOL: 120
		.0262				.013	MFG:

TITLE ______ DWG. NO. 610R014 "A"

CSS 140

MATERIAL	COMPONENT	ADV. MATL.
6-4 Ti STA	U. Skin and Core	Yes
8823 Ti	L. Skin and Spars	Yes
Ti Braze Alloy	Core to Skin Braze	Yes

MFG. PROCESS	COMPONENT	ADV. METH.
Form	Skins to Contour	Yes
Form and Mach.	Corrugated Core	Yes
Weld	Spot Weld Core	Yes
Weld	Spar Webs and Caps	Yes
Braze	Spars and Core to Skins	Yes

COMMENTS:

Need development of full depth core making facilities.

Need braze alloy, brazing development and large brazing furnaces.

CONCEPT RATING

ADVANCED TECHNOLOGY			MANUFACTURING				COST FACTOR
MFG.	MATL.	TOTAL .09	BASIC	SECOND	FINAL	TOTAL .004	TOOL: 260 MFG:

TITLE		DWG. NO.	610R-015 "C"
		CSS	140

MATERIAL	COMPONENT	ADV. MATL.
6-4 Ti EXT	Skin Frame	Yes
6-4 Ti	Skins	Yes
6-4 Ti TUBE	Truss	Yes

MFG. PROCESS	COMPONENT	ADV. METH.
Weld (Hand)	Frame & Tube Truss	Yes
Form	Frame & Skin Details	Yes
Braze Assy.	Skin to Frame	Yes

COMMENTS:

Tube and frame to be hand welded.

Large brazing facility required.

Inspection after brazing very difficult.

CONCEPT RATING

ADVANCED TECHNOLOGY			MANUFACTURING				COST FACTOR
MFG.	MATL.	TOTAL .045	BASIC	SECOND	FINAL	TOTAL .0026	TOOL: 400 MFG:

TITLE ______________________ DWG. NO. 610R-016 "A"

CSS 140

MATERIAL	COMPONENT	ADV. MATL.
7050-T7651 Alum	Upper Cover	Yes
7050-T73651 Alum	Spars	Yes
7475-T7351 Alum	Lower Plate	Yes

MFG. PROCESS	COMPONENT	ADV. METH.
Machine Hog-Out	All	None
Rivet & Bolt	Assy.	None

COMMENTS:

Conventional Forming and machining.

No provisions for fuel flow holes shown.

CONCEPT RATING

ADVANCED TECHNOLOGY			MANUFACTURING				COST FACTOR
MFG.	MATL.	TOTAL .0225	BASIC	SECOND	FINAL	TOTAL .020	TOOL: 100 MFG:

TITLE		DWG. NO.	610R-017 "B"
		CSS	140

MATERIAL	COMPONENT	ADV. MATL.
6-4 Ti STA	All except H/C Core	Yes
5052 Alum	H/C Core	No

MFG. PROCESS	COMPONENT	ADV. METH.
Weld, T-Burn	U/L Skin Panels	Yes
Form	U/L Skin Panel Covers	Yes
Bolt Assy.	U/L Spar-Skin Joints	No

COMMENTS:

T-Burn welds as proposed for closing skin panels will have to be developed.

Welds shown in View A are not applicable to GTA burn thru.

CONCEPT RATING

ADVANCED TECHNOLOGY			MANUFACTURING				COST FACTOR
MFG.	MATL.	TOTAL	BASIC	SECOND	FINAL	TOTAL	TOOL: 235
		.06				.0027	MFG:

TITLE ______ DWG. NO. 610R-018

CSS 140

MATERIAL	COMPONENT	ADV. MATL.
8823 Ti	All	Yes

MFG. PROCESS	COMPONENT	ADV. METH.
Weld	"Y" Stiff & Spars	Yes
Weld, T-Burn	Spars to L Skin	Yes
Form	Skins	Yes
Bolt Assy.	U. Skin-Spar Cap	No

COMMENTS:

Need spars and stiffeners parallel.

T-Burn attachment for spar cap and lower skin not good.

Y stiffener attachment to skins will require development.

CONCEPT RATING

ADVANCED TECHNOLOGY			MANUFACTURING				COST FACTOR
MFG.	MATL.	TOTAL	BASIC	SECOND	FINAL	TOTAL	TOOL: 225
		.075				.0066	MFG:

TITLE ______ DWG. NO. 610R-019-1

CSS 140

MATERIAL	COMPONENT	ADV. MATL.
6-4 Ti	U/Skin	Yes
8823 Ti	L/Skin & Spars	Yes

MFG. PROCESS	COMPONENT	ADV. METH.
Form	Skin & Integ. Stiff	Yes
Rivet, Adh. Bond, or Braze	Skin Panels	Yes

COMMENTS:

Developments required to equipment and process of forming integral skin stiffeners.

Contour forming of integral stiffened skins and bonding or brazing will be major problems.

CONCEPT RATING

ADVANCED TECHNOLOGY			MANUFACTURING				COST FACTOR
MFG.	MATL.	TOTAL .06	BASIC	SECOND	FINAL	TOTAL .004	TOOL: 325 MFG:

TITLE ______ DWG. NO. 610R-019-2

CSS 140

MATERIAL	COMPONENT	ADV. MATL.
7050 AL	All	Yes

MFG. PROCESS	COMPONENT	ADV. METH.
Form	Skins & Integral Stiff.	Yes
Assy.	Rivet or Adhesive Bond	No
Bolt	U-Skin Spar	No

COMMENTS:

Forming of bulb stiffeners is very difficult and must be parallel.

CONCEPT RATING

ADVANCED TECHNOLOGY			MANUFACTURING				COST FACTOR
MFG.	MATL.	TOTAL .045	BASIC	SECOND	FINAL	TOTAL .008	TOOL: 275 MFG:

TITLE		DWG. NO.	610R020 "A"
		CSS	140

MATERIAL	COMPONENT	ADV. MATL.
6-4 Ti	All	Yes

MFG. PROCESS	COMPONENT	ADV. METH.
Form	Skins to Contour	Yes
Form	Truss Core	Yes
Weld-Burn Thru	Inner Skin & Truss Core	Yes
Braze (or D.B.)	Outer Skin & Truss Core	Yes
Bolt	Spars to Skin Panels	No

COMMENTS:

Large area brazing developments and brazing alloy developments are required.

Revise butt weld and burn thru joint to make separate welds.

CONCEPT RATING

ADVANCED TECHNOLOGY			MANUFACTURING				COST FACTOR
MFG.	MATL.	TOTAL .0837	BASIC	SECOND	FINAL	TOTAL .010	TOOL: 315 MFG:

TITLE	DWG. NO. 610R-021
	CSS 140

MATERIAL	COMPONENT	ADV. MATL.
8823 Ti or 6-4 Ti	All	Yes

MFG. PROCESS	COMPONENT	ADV. METH.
Machine	Spars	No
Form	Skins	Yes
Weld (T-Burn)	Skin/Stiff	Yes
Bolt-Assy.	U/Skin & Spar	No

COMMENTS:

Need to develop standard T-burn thru welding tool or equipment.

Possible to make T stiffener as a detail by CSDB.

CONCEPT RATING

ADVANCED TECHNOLOGY			MANUFACTURING				COST FACTOR
MFG.	MATL.	TOTAL .0636	BASIC	SECOND	FINAL	TOTAL .008	TOOL: 210 MFG:

TITLE ____________ DWG. NO. 610R-022 "A"

CSS 140

MATERIAL	COMPONENT	ADV. MATL.
-(1) 6-4 Ti	All	Yes
-(2) 8823 Ti	L/Skin Only	Yes
6-4 Ti	All Other	Yes

MFG. PROCESS	COMPONENT	ADV. METH.
Adh. Bond Lam.	U/L Skins & Spars	Yes
Form	Skins & Stiff (HAT)	Yes
Bolt Assy.	U/Skin and Spar Cap	No

COMMENTS:

Problem: Wide area laminate bonding - hat sections must be parallel.

CONCEPT RATING

ADVANCED TECHNOLOGY			MANUFACTURING				COST FACTOR
MFG.	MATL.	TOTAL .045	BASIC	SECOND	FINAL	TOTAL .009	TOOL: 160 MFG:

TITLE		DWG. NO.	610R-023
		CSS	140

MATERIAL	COMPONENT	ADV. MATL.
8823 Ti	All	Yes

MFG. PROCESS	COMPONENT	ADV. METH.
Mach. (Alt. Extrude)	Spars	No
Form	Skins	Yes
Weld (T-Burn)	Skin/Stiff	Yes
Bolt-Assy.	U/Skin & Spars	No

COMMENTS:

Need to develop standard T-burn thru welding tool or equipment.

Assume stiff to be constant spacing.

Make 2 welds on spars to avoid excess machining. Look at rivet bonded web for inner spars.

Suggest integral panel extrusion for trade study.

CONCEPT RATING (-1 & -2)

ADVANCED TECHNOLOGY			MANUFACTURING				COST FACTOR
MFG.	MATL.	TOTAL .06	BASIC	SECOND	FINAL	TOTAL .012	TOOL: 185 MFG:

TITLE ______________________ DWG. NO. 610R-024 "A"

CSS 140

MATERIAL	COMPONENT	ADV. MATL.
6-4 Ti	U. Skin Panels	Yes
8823 Ti	L. Skin & Spar	Yes
5052 AL	H/C Core - Spars	No

MFG. PROCESS	COMPONENT	ADV. METH.
Form	Panel Skins to Contour	Yes
Form	Truss Core for Panels	Yes
Weld	Inner Panel Skin to Truss/Spar	Yes
Braze (or D. B.)	Outer Skin to Truss/Spar	Yes
Adh. Bond	Spar Panels	Yes
Bolt	Spar to Skin Panel Assy.	No

COMMENTS:

Large area brazing developments and brazing alloy developments are required.

Look at rivet bonding of spar panels at lower surface attach points.

CONCEPT RATING

ADVANCED TECHNOLOGY			MANUFACTURING				COST FACTOR
MFG.	MATL.	TOTAL .084	BASIC	SECOND	FINAL	TOTAL .0105	TOOL: 325 MFG:

TITLE ______ DWG. NO. 610R-025

CSS 140

MATERIAL	COMPONENT	ADV. MATL.
7050 Alum (S/M)	All	Yes

MFG. PROCESS	COMPONENT	ADV. METH.
Shear-Route-Form	All Det	No
Adh. Bond	Spar-Skin & Hat Stiff	No
Adh. Bond	Spars - Back to Back	No
Bolt	Assy-U/Skin & Spar	No

COMMENTS:

Advanced development of laminate bonding is required.

CONCEPT RATING

ADVANCED TECHNOLOGY			MANUFACTURING				COST FACTOR
MFG.	MATL.	TOTAL .03	BASIC	SECOND	FINAL	TOTAL .017	TOOL: 130 MFG:

(See 610R-119)

TITLE		DWG. NO.	610R-026
		CSS	140

MATERIAL	COMPONENT	ADV. MATL.
7050-T76 - Sheet	Spar Webs Skins-Truss	Yes
2024 - Extrusion	Spar Cap	No

MFG. PROCESS	COMPONENT	ADV. METH.
Adh. Bonding	Truss Skin Panels	No
Truss Forming	Corrugation Truss	No
Extrusion (Machined)	Spar Cap	No
Bolt Assy.	Spar-Skins	No

COMMENTS:

Major problem is equipment development for forming truss core.

Assy. problem is closing of wing box due to internal bolts.

Wide area bonding of skins requires development.

CONCEPT RATING

ADVANCED TECHNOLOGY			MANUFACTURING				COST FACTOR
MFG.	MATL.	TOTAL .026	BASIC	SECOND	FINAL	TOTAL .008	TOOL: 170 MFG:

(See 610R-118)

TITLE		DWG. NO.	610R-027
		CSS	140

MATERIAL	COMPONENT	ADV. MATL.
6-4 Ti STA	U/Skin & Spars	Yes
8823 Ti	L/Skin	Yes
5052 Alum	H/C Core	No

MFG. PROCESS	COMPONENT	ADV. METH.
Adh. Bond Panel	U/L/Skins	No
Adh. Bond Laminate	Spars	Yes
Bolt Assy.	U/Skin-Spar	No

COMMENTS:

Wide area bonding of skin panels and spar laminates are problem areas.

CONCEPT RATING

ADVANCED TECHNOLOGY			MANUFACTURING				COST FACTOR
MFG.	MATL.	TOTAL .0225	BASIC	SECOND	FINAL	TOTAL .010	TOOL: 140 MFG:

TITLE ______ DWG. NO. 610R-028

CSS 140

MATERIAL	COMPONENT	ADV. MATL.
7050-T76	Skins	Yes
7050-T7651	Skin Panel Slugs	Yes
5056-AL Core	Sandwich Core	No

MFG. PROCESS	COMPONENT	ADV. METH.
Adhesive Bonding	All	No
Machine	Slugs	No
Bolted Assy.	U. Skin - Spar Caps	No

COMMENTS:

Problem:

- Wide area bonding
- Bonding of spar laminates to lower skin panel.

CONCEPT RATING

ADVANCED TECHNOLOGY			MANUFACTURING				COST FACTOR
MFG.	MATL.	TOTAL .0225	BASIC	SECOND	FINAL	TOTAL .0105	TOOL: 135 MFG:

TITLE		DWG. NO.	610R-029
		CSS	140

MATERIAL	COMPONENT	ADV. MATL.
7050-T761 (Plate)	U. Skin & F/R Spars	Yes
7050-T76 (Sheet)	L. Skin & Corr. Spars	Yes
7050-T761 (Bar)	Spar Caps	Yes

MFG. PROCESS	COMPONENT	ADV. METH.
Brake Form & Machine	U. Skin	No
Machine	U. Spar Caps	No
Machine	F & R Spar	No
Form -	Corr. Spar Webs	No
Adh. Bond	L. Skin Laminate	Yes
Weld Bond	Corr. Spar to L.S.Caps	Yes

COMMENTS:

Laminated bonded lower skin and spar caps will require development.

Weld bonding of 7050 alum will need development. Suggest rivet bonding of upper and lower spar caps to webs be evaluated in trade study.

CONCEPT RATING

ADVANCED TECHNOLOGY			MANUFACTURING				COST FACTOR
MFG.	MATL.	TOTAL .0375	BASIC	SECOND	FINAL	TOTAL .013	TOOL: 125 MFG:

TITLE ______________________ DWG. NO. 610R-030

CSS 140

MATERIAL	COMPONENT	ADV. MATL.
7050 Aluminum	All	Yes

MFG. PROCESS	COMPONENT	ADV. METH.
Form - Corrugations	Skin Stiff.	No
Form - Contour	Skins	No
Machine	Spars	No
Adh. Bonding	Skin-to-Stiff	No
Bolt Assy	Skin-to-Spars	No

COMMENTS:

Requires equipment development for forming corrugated stiffeners.

Assume corrugated stiffeners to be parallel.

Wide area adhesive bonding of aluminum laminates needs development.

CONCEPT RATING

ADVANCED TECHNOLOGY			MANUFACTURING				COST FACTOR
MFG.	MATL.	TOTAL .0338	BASIC	SECOND	FINAL	TOTAL .001	TOOL: 170 MFG:

TITLE		DWG. NO.	610R-031
		CSS	140

MATERIAL	COMPONENT	ADV. MATL.
7050 Alum.	U. Skin & U. Spar	Yes
8823 Ti	L. Skin & L. Spar	Yes

MFG. PROCESS	COMPONENT	ADV. METH.
Adh. Bond	U. Skin Panel	No
Weld-"T" Burn	L. Skin Panel	Yes
Braze	L. Spar to Skin	Yes
Bolted Assy	U. Spar to Skin Panel	No

COMMENTS:

Problems: Wide area bonding of upper panel. Need a low temp braze alloy.
Suggest rivet bonding for spar webs.
Look at increased flange width of lower spar caps and consider adhesive bonding rather than braze.

CONCEPT RATING

ADVANCED TECHNOLOGY			MANUFACTURING				COST FACTOR
MFG.	MATL.	TOTAL	BASIC	SECOND	FINAL	TOTAL	TOOL: 180
		.0562				.008	MFG:

TITLE ______________________ DWG. NO. 610R-100

CSS 340

MATERIAL	COMPONENT	ADV. MATL.
7050 Alum 5056 Alum	All	Yes

MFG. PROCESS	COMPONENT	ADV. METH.
Form	Skins, Panel & Truss Core	No
Weld Bond	Truss Core	Yes
Adh. Bond	Skin Panels & Spars	No
Rivet Assy	Spar Assy	No
Bolt Assy	U. Skin Panel & Spars	No

COMMENTS:

Trussed core fabrication method will have to be developed.

Assembly and bonding of lower skin is complicated by rivets shown in View A-A. Suggest elimination of these rivets in favor of bonding only or double flush rivets.

Major problem is wide area bonding.

CONCEPT RATING

ADVANCED TECHNOLOGY			MANUFACTURING				COST FACTOR
MFG.	MATL.	TOTAL .0337	BASIC	SECOND	FINAL	TOTAL .013	TOOL: 145 MFG:

TITLE	DWG. NO. 610R-101"B"
	CSS 340

MATERIAL	COMPONENT	ADV. MATL.
6-4 Ti	U. Skin & Core	Yes
8823 Ti	U. Skin & Spars	Yes
Braze Alloy	Core to Skin Braze	Yes

MFG. PROCESS	COMPONENT	ADV. METH.
Form	Skins and Spars to Contour	Yes
Form	Beads on Large Cell Core	Yes
Spot Weld & Mach.	Large Cell Core	Yes
Braze Assy	Skins, Spars, and Core	Yes

COMMENTS:

Very complex fabrication methods require development.
Low temp brazing alloy is needed.
Large scale brazing facilities are required.

CONCEPT RATING

ADVANCED TECHNOLOGY			MANUFACTURING				COST FACTOR
MFG.	MATL.	TOTAL .09	BASIC	SECOND	FINAL	TOTAL .0013	TOOL: 440 MFG:

TITLE ______ DWG. NO. 610R-102"B"

C S S 340

MATERIAL	COMPONENT	ADV. MATL.
7050 Alum (.012-.016)	Skins	Yes
7050 Alum Sheet (.016)	Inner Spars	Yes
7050 Alum Plate	F & R Spars	Yes

MFG. PROCESS	COMPONENT	ADV. METH.
Forming) Adhesive Bonding)	(Skin Laminates (Spar Laminates	Yes
Adhesive Bonding	Skin-Spar-Assy	Yes

COMMENTS:

This concept requires development of a new bonding technique.

Question: Will skin-spar assembly support bonding pressures?

CONCEPT RATING

ADVANCED TECHNOLOGY			MANUFACTURING				COST FACTOR
MFG.	MATL.	TOTAL .045	BASIC	SECOND	FINAL	TOTAL .004	TOOL: 240 MFG:

TITLE ______ DWG. NO. 610R-103A

CSS 340

MATERIAL	COMPONENT	ADV. MATL.
6-4 Ti	All	Yes

MFG. PROCESS	COMPONENT	ADV. METH.
Form	Skins, Truss, & Spar Caps	Yes
Adh. Bond	U. Skin Pan. & Spar Panels	Yes
Braze	L. Skin Pan. & Spar Panels	Yes
Weld	Truss-Spar Pan. & L.Skin Panels	Yes
Bolt Assy	U. Skin Pan & Spar Caps	No

COMMENTS:

Wide area bonding and brazing of skin panels are major problem areas.

Joining of spar panels to lower skin attachment will require development.

CONCEPT RATING

ADVANCED TECHNOLOGY			MANUFACTURING				COST FACTOR
MFG.	MATL.	TOTAL .071	BASIC	SECOND	FINAL	TOTAL .0053	TOOL: 245 MFG:

TITLE ______ DWG. NO. 610R-105

CSS 340

MATERIAL	COMPONENT	ADV. MATL.
7050 Alum	All (except Core)	Yes
5056 Alum	Core	No

MFG. PROCESS	COMPONENT	ADV. METH.
Form	Skins, Truss, Braces/Beads	Yes
Mach.	Spars (Spar Caps)	No
Adh. Bond	Spars (H/C Panels)	No
" "	U/Truss Skin Pan-L/Lam.Skin Pan.	Yes
Bolt Assy	U/L Skin Pan to Spar	No

COMMENTS:

Need developments for upper truss skin forming and bonding.

Wide area bonding is a major problem with laminated skins.

Upper skin-spar attachment not possible as shown.

CONCEPT RATING

ADVANCED TECHNOLOGY			MANUFACTURING				COST FACTOR
MFG.	MATL.	TOTAL .03	BASIC	SECOND	FINAL	TOTAL .008	TOOL: 185 MFG:

TITLE		DWG. NO.	610R-106
		CSS	340

MATERIAL	COMPONENT	ADV. MATL.
7050 Alum.	U. Skin	Yes
6-4 Ti	U. Spar Cap	Yes
8823 Ti	F/R Spars-L.Spar Caps	Yes
	L. Skin Pan (Skin & Core)	Yes

MFG. PROCESS	COMPONENT	ADV. METH.
Form & Etch	Upper Skin	No
Extrude & Mach	Spars-Spar Caps	Yes
Braze	Lower Skin Panel	Yes
Adhesive Bond	Aux. Spar Panels	Yes
Bolt Assy	U. Skin to Spars	No

COMMENTS:

Major problem with braze alloy, core manufacture, core machining, and large area brazed panel for lower skin panel.

Joining of adhesive bonded spar panels to brazed lower skin panels is a problem not resolved.

CONCEPT RATING

ADVANCED TECHNOLOGY			MANUFACTURING				COST FACTOR
MFG.	MATL.	TOTAL .0525	BASIC	SECOND	FINAL	TOTAL .0066	TOOL: 195 MFG:

TITLE ______ DWG. NO. 610R-107

CSS 340

MATERIAL	COMPONENT	ADV. MATL.
8823 Ti	U. Skin Pan	Yes
8823 Ti	Spar Pan	Yes
6-4 Ti	Aux. Spar Caps, Lower	Yes
6-4 Ti	L. Skin Pan (H/C)	Yes
6-4 Ti	Truss, Lower Spar Cap	Yes

MFG. PROCESS	COMPONENT	ADV. METH.
Form	U/L Skins & Truss	Yes
Adh. Bond	U. Skin Pan - Spar Pan	Yes
Weld	F/R Spar Caps	Yes
Braze	L. Skin Pan	Yes
Bolt Assy	U. Skin & Spars	No

COMMENTS:

Wide area bonding and brazing are major problems.

Forming of truss cap for lower fitting assembly needs development.

CONCEPT RATING

ADVANCED TECHNOLOGY			MANUFACTURING				COST FACTOR
MFG.	MATL.	TOTAL .04	BASIC	SECOND	FINAL	TOTAL .0053	TOOL: 180 MFG:

TITLE ____________ DWG. NO. 610R-108

CSS 340

MATERIAL	COMPONENT	ADV. MATL.
6-4 Ti (.005)	Corr Core	Yes
8823 Ti	U/L Skins	Yes
Braze Alloy, Ti	Core to Core Node	Yes

MFG. PROCESS	COMPONENT	ADV. METH.
Spot Weld and Mach.	Core to Core	Yes
Braze, Assy	Core to Skins	Yes
Forming	Core Cells	Yes
Forming, Creep	Skins	Yes

COMMENTS:

Need development of full depth core making facility and process.

Need low temp. brazing alloy for lower skin (6-4 to 8823).

Large brazing tools and facility needed.

Question: Would CP Ti be acceptable as core material?

CONCEPT RATING

ADVANCED TECHNOLOGY			MANUFACTURING				COST FACTOR
MFG.	MATL.	TOTAL .09	BASIC	SECOND	FINAL	TOTAL .004	TOOL: 300 MFG:

TITLE	DWG. NO.	610R-109
	CSS	340

MATERIAL	COMPONENT	ADV. MATL.
6-4 Titanium	All	Yes

MFG. PROCESS	COMPONENT	ADV. METH.
T-Burn Weld	U/L Skin/Stiff	Yes
Form Skin/Stiff	" " "	Yes
Rivet and Bolt	Assembly	No

COMMENTS:

Use Std. tooling for all T-Burn Welds.

CONCEPT RATING

ADVANCED TECHNOLOGY			MANUFACTURING				COST FACTOR
MFG.	MATL.	TOTAL .03	BASIC	SECOND	FINAL	TOTAL .016	TOOL: 120 MFG:

TITLE		DWG. NO.	610R-110
		CSS	340

MATERIAL	COMPONENT	ADV. MATL.
6-4 Ti Annealed	All	

MFG. PROCESS	COMPONENT	ADV. METH.
Forming		

COMMENTS:

Need to revise outer skin to spar cap weld joint.

Welding .015 skin to spar cap is a major problem.

.125 flat on 60^{o} diagonal not possible.

CONCEPT RATING

ADVANCED TECHNOLOGY			MANUFACTURING				COST FACTOR
MFG.	MATL.	TOTAL .075	BASIC	SECOND	FINAL	TOTAL .0033	TOOL: 280 MFG:

TITLE ______________________ DWG. NO. 610R-111

CSS 340

MATERIAL	COMPONENT	ADV. MATL.
6-4 Ti	All	Yes

MFG. PROCESS	COMPONENT	ADV. METH.
Form	Skins	Yes
Weld (Alt. Bz)	Skin Panels	Yes
Bolt Assy	Skin Panels & Spars	No

COMMENTS:

Difficult to make skin panels by 100% weld-possibly braze outer skins.

Attachment, skin panel to intermediate spars, very difficult.

CONCEPT RATING

ADVANCED TECHNOLOGY			MANUFACTURING				COST FACTOR
MFG.	MATL.	TOTAL	BASIC	SECOND	FINAL	TOTAL	TOOL: 250
		.052				.0053	MFG:

TITLE		DWG. NO.	610R-112
		CSS	340

MATERIAL	COMPONENT	ADV. MATL.
7475 T7651 Plate	Lower Skin	Yes
7050 T651 Plate	Upper Skin	Yes

MFG. PROCESS	COMPONENT	ADV. METH.
Machine Complete (All Details)	All Details	No
Bolt	Assy	No

COMMENTS:

Conventional forming & machining.

CONCEPT RATING

ADVANCED TECHNOLOGY			MANUFACTURING				COST FACTOR
MFG.	MATL.	TOTAL .022	BASIC	SECOND	FINAL	TOTAL .020	TOOL: 115 MFG:

TITLE		DWG. NO.	610R113"A"
		CSS	340

MATERIAL	COMPONENT	ADV. MATL.
6-4 Ti Annealed	All	Yes

MFG. PROCESS	COMPONENT	ADV. METH.
Mach From Plate (.65)	Upper Skin	No
Mach From Plate (.500)	Lower Skin	No
Creep Form	U/L Plates	Yes
Weld-	Spar Web/Cap	Yes
Bolt Assy	U/Skin & Spar	No

COMMENTS:

Need to increase stiffener spacing to allow for larger cutters for producibility.

Will have to etch .030 off all surfaces to hold dimensions as shown.

Look at integral stiffened skin extrusions in trade-off studies.

CONCEPT RATING

ADVANCED TECHNOLOGY			MANUFACTURING				COST FACTOR
MFG.	MATL.	TOTAL .037	BASIC	SECOND	FINAL	TOTAL .013	TOOL: 200 MFG:

TITLE ______ DWG. NO. 610R-114

CSS 340

MATERIAL	COMPONENT	ADV. MATL.
6-4 Ti Annealed	All	Yes

MFG. PROCESS	COMPONENT	ADV. METH.
Butt Weld	Skin-Spar Joints	Yes
Braze	Skin to Stiff	Yes
Form	Truss Core	Yes
Bolt Assy	U/L Skin Panel & Spars	No

COMMENTS:

Need spars and corrugations parallel.

Problem of accessibility in closing wing box.

CONCEPT RATING

ADVANCED TECHNOLOGY			MANUFACTURING				COST FACTOR
MFG.	MATL.	TOTAL .084	BASIC	SECOND	FINAL	TOTAL .0033	TOOL: 220 MFG:

TITLE ______ DWG. NO. 610R-115-1

CSS 340

MATERIAL	COMPONENT	ADV. MATL.
7050 Alum	All	Yes

MFG. PROCESS	COMPONENT	ADV. METH.
Machine Complete and Form	Skins	Yes
Machine	Spars	No
Bolt-Rivet Assy	Skin-Spars	No

COMMENTS:

Need greater spacing between stiffeners for cutter size required.

CONCEPT RATING

ADVANCED TECHNOLOGY			MANUFACTURING				COST FACTOR
MFG.	MATL.	TOTAL	BASIC	SECOND	FINAL	TOTAL	TOOL: 150
		.03				.013	MFG:

TITLE ______ DWG. NO. 610R-115-2

CSS 340

MATERIAL	COMPONENT	ADV. MATL.
6-4 Ti	All	Yes

MFG. PROCESS	COMPONENT	ADV. METH.
Machine	Spars-Stiff.	No
Form	Skins	Yes
Weld (T-Burn)	Stiff to Skins	Yes
Bolt Assy	Skin-Spars	No

COMMENTS:

Suggest T extrusions for stiffeners or integral panel extrusions with butt weld joints for trade study.

Larger spacing between stiffeners is desired for machining or welding.

CONCEPT RATING

ADVANCED TECHNOLOGY			MANUFACTURING				COST FACTOR
MFG.	MATL.	TOTAL .037	BASIC	SECOND	FINAL	TOTAL .007	TOOL: 215 MFG:

TITLE ______________________ DWG. NO. 610R116

CSS 340

MATERIAL	COMPONENT	ADV. MATL.
7050 Aluminum	All	Yes

MFG. PROCESS	COMPONENT	ADV. METH.
Forming-Corr. Stiff.	Skin Stiff	No
Machine	Spars	No
Adh. Bonding	Skin to Stiff	No
Bolt Assy	Skin to Spar	No

COMMENTS:

Requires equipment development for forming corrugated stiffeners.

Development of bonding laminates required.

CONCEPT RATING

ADVANCED TECHNOLOGY			MANUFACTURING				COST FACTOR
MFG.	MATL.	TOTAL .034	BASIC	SECOND	FINAL	TOTAL .013	TOOL: 165 MFG:

TITLE ______ DWG. NO. 610R-117

CSS 340

MATERIAL	COMPONENT	ADV. MATL.

MATERIAL	COMPONENT	ADV. MATL.
7050 Alum	All	Yes

MFG. PROCESS	COMPONENT	ADV. METH.
Form	Skins & Spars	No
Adh. Bond	U/L Skin Panels	No
Bolt Assy	Skin-Spars	No

COMMENTS:

Major problem is wide area bonding.

CONCEPT RATING

ADVANCED TECHNOLOGY			MANUFACTURING				COST FACTOR
MFG.	MATL.	TOTAL .022	BASIC	SECOND	FINAL	TOTAL .013	TOOL: 135 MFG:

TITLE		DWG. NO.	610R-118
		CSS	340

MATERIAL	COMPONENT	ADV. MATL.
7050 Alum	All	Yes

MFG. PROCESS	COMPONENT	ADV. METH.
Form	Truss Core & Skins	No
Extrude & Mach.	Spar Caps	No
Bolt Assy	Skin Panels to Spars	No
Adhesive Bond	Truss Core & Skins	No

COMMENTS:

Assume corrugation truss members to be parallel.
Major problem is wide area bonding.
Closing of box with internal bolts is an assembly problem.

CONCEPT RATING

ADVANCED TECHNOLOGY			MANUFACTURING				COST FACTOR
MFG.	MATL.	TOTAL .026	BASIC	SECOND	FINAL	TOTAL .008	TOOL: 170 MFG:

(See 610R-026)

TITLE		DWG. NO.	610R-119
		CSS	340

MATERIAL	COMPONENT	ADV. MATL.
7050 Alum	All	Yes

MFG. PROCESS	COMPONENT	ADV. METH.
Form	Laminate Skins & Spars	No
"	Hat Stiff & Spar Caps	No
Adh. Bond	Hats, Lam. Skins & Spars	Yes
Bolt Assy	U. Skin & Spar Cap	No

COMMENTS:

Wide area bonding of laminated skins and spars is the major problem.

CONCEPT RATING

ADVANCED TECHNOLOGY			MANUFACTURING				COST FACTOR
MFG.	MATL.	TOTAL .03	BASIC	SECOND	FINAL	TOTAL .017	TOOL: 130 MFG:

(See 610R-025)

TITLE ______ DWG. NO. 610R-120

CSS 340

MATERIAL	COMPONENT	ADV. MATL.
7050 Alum	All	Yes

MFG. PROCESS	COMPONENT	ADV. METH.
Form	Integral Stiff Skin	Yes
Form	Skin Laminates	No
Machine	Spars	No
Adhesive Bond	Skin Panels	Yes
Bolt Assy	U. Skin & Spar	No

COMMENTS:

Forming of integral stiffened skins is a major problem. Assume that stiffeners will be parallel.

Adhesive bonding of laminated skin panels needs development.

CONCEPT RATING

ADVANCED TECHNOLOGY			MANUFACTURING				COST FACTOR
MFG.	MATL.	TOTAL .041	BASIC	SECOND	FINAL	TOTAL .011	TOOL: 150 MFG:

(See 610R-019-2)

SECTION II.4

CATALOG OF

CROSS-SECTION DRAWINGS

CROSS-SECTION CONCEPTS

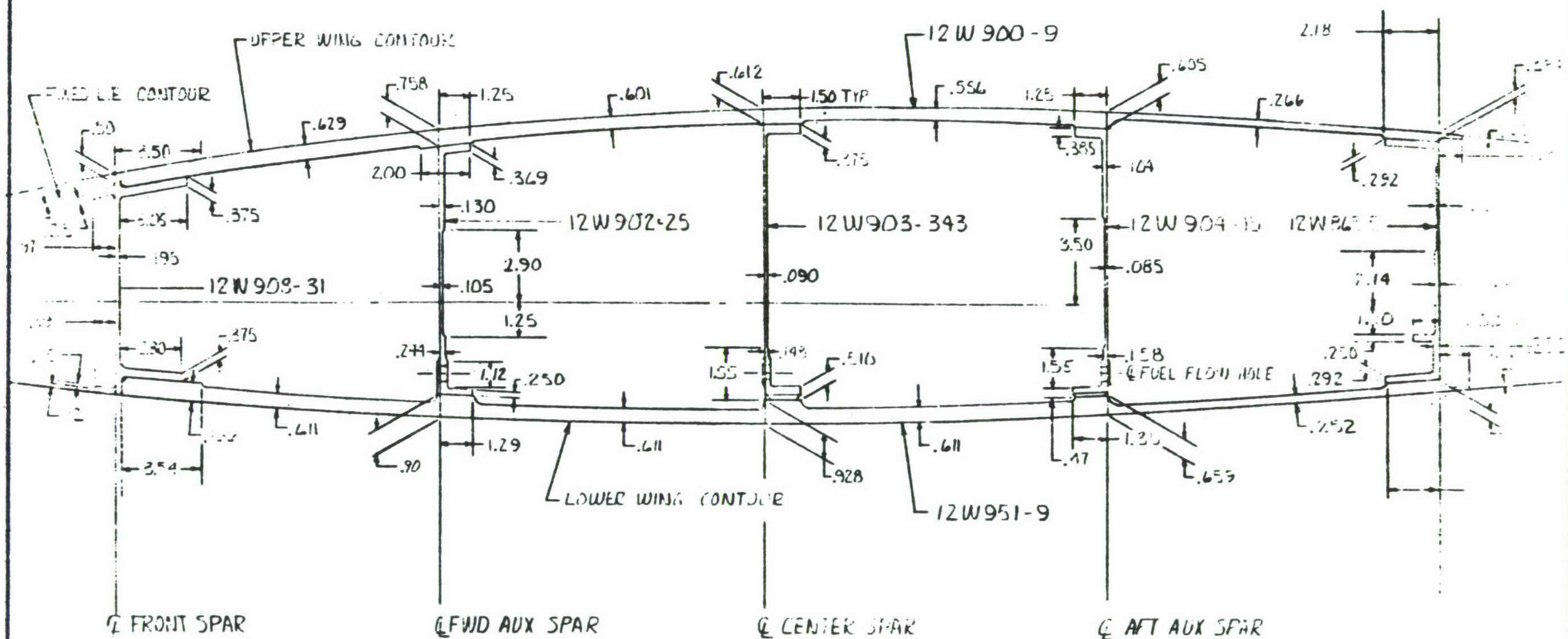
FOR CENTER SPAR STATION 140.0

DRAWING NO. 610R-000 THROUGH 610R-031

WTS ~ 1" OF CROSS-SECTION		
PART	RAW STOCK WEIGHT	FINISHED WEIGHT
UPPER SKIN	6.00#	2.82#
LOWER SKIN	6.00	2.99
SPARS	11.25	1.33
	TOTAL	7.14#

CROSS SECTION CONCEPT 610R-000

TITLE F-111F WING BOX - CROSS SECTION CUT AT CENTER SPAR STATION 14.3



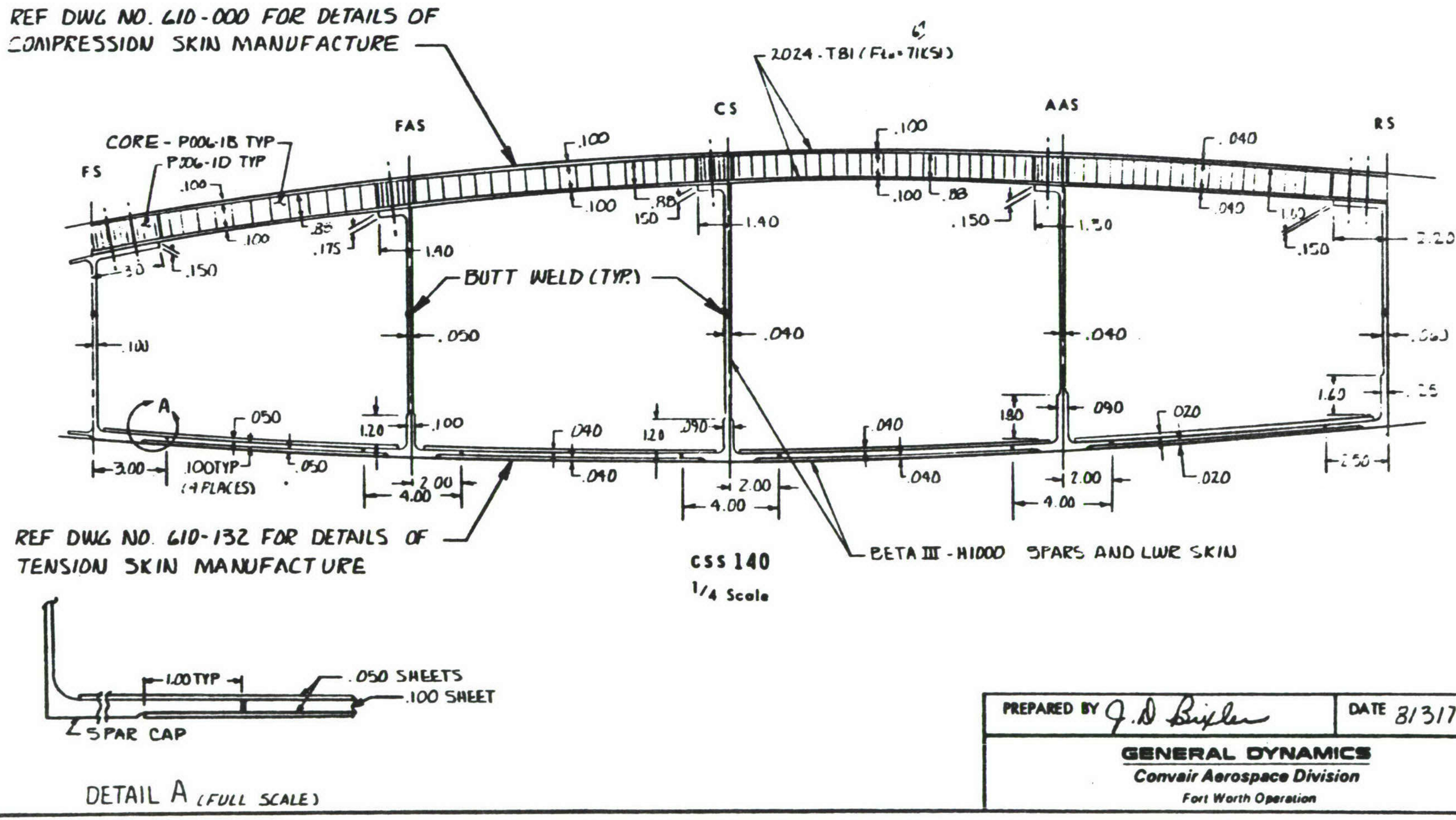
SCALE : 1/4

PREPARED BY G.N. Rix... DATE 6/12/...

GENERAL DYNAMICS
Convair Aerospace Division
Fort Worth Operation

CROSS SECTION CONCEPT 610R-001

TITLE WING SECTION ~ WELDED SPARS, CONSTANT DEPTH SANDWICH UPPER SKIN, LAMINATED LOWER SKIN WITH EXTERNAL SPAR CAPS.



PREPARED BY J. D. Bixler DATE 8/3/72

GENERAL DYNAMICS
Convair Aerospace Division
Fort Worth Operation

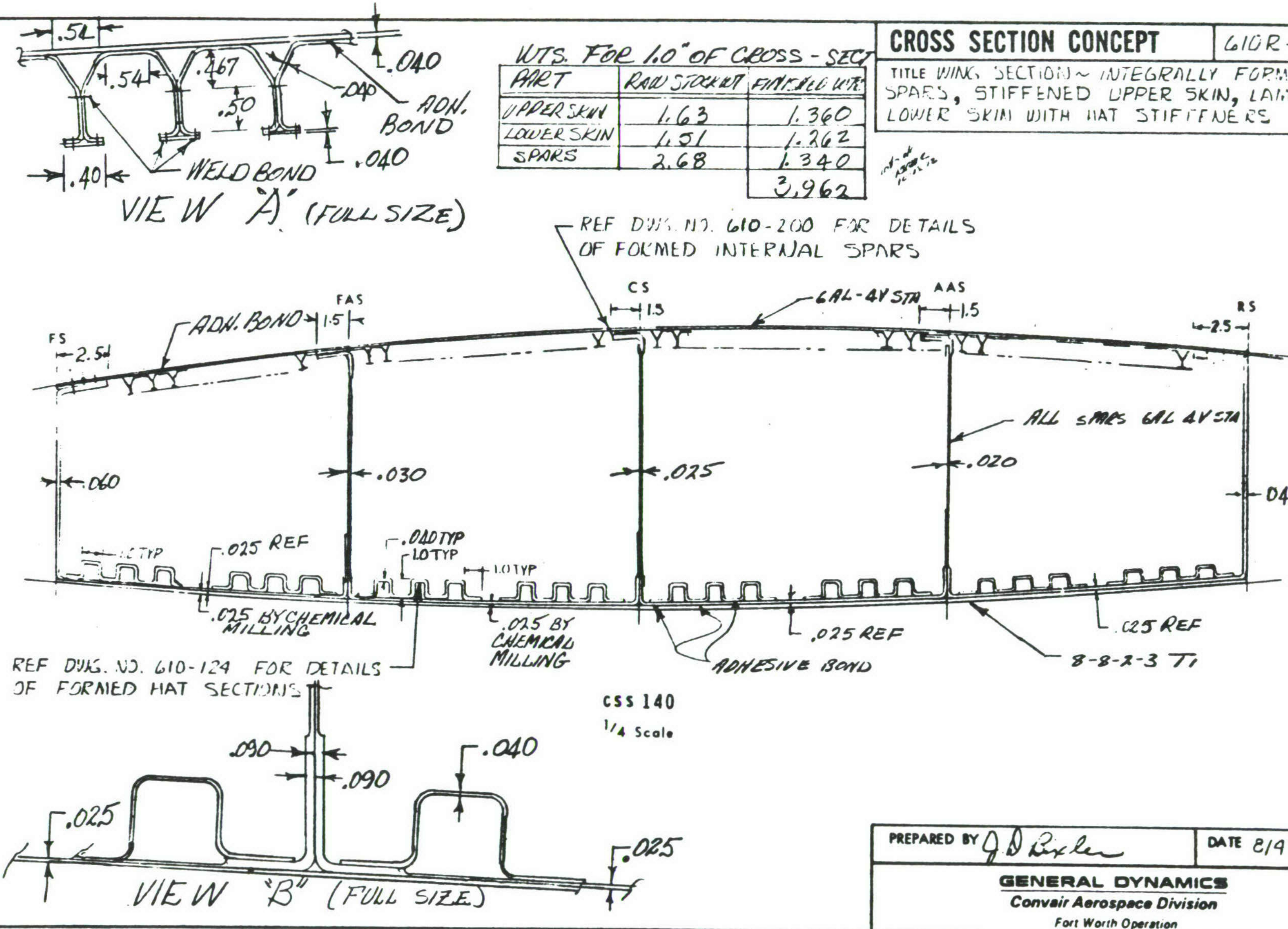
CROSS SECTION CONCEPT

610R-002A

TITLE WING SECTION ~ INTEGRALLY FORMED SPARS, STIFFENED UPPER SKIN, LAMINATED LOWER SKIN WITH HAT STIFFENERS

WTS. FOR 1.0" OF CROSS - SECT

PART	RAW STOCK WT	FINISHED WT
UPPER SKIN	1.63	1.360
LOWER SKIN	1.51	1.262
SPARS	2.68	1.340
		3.962

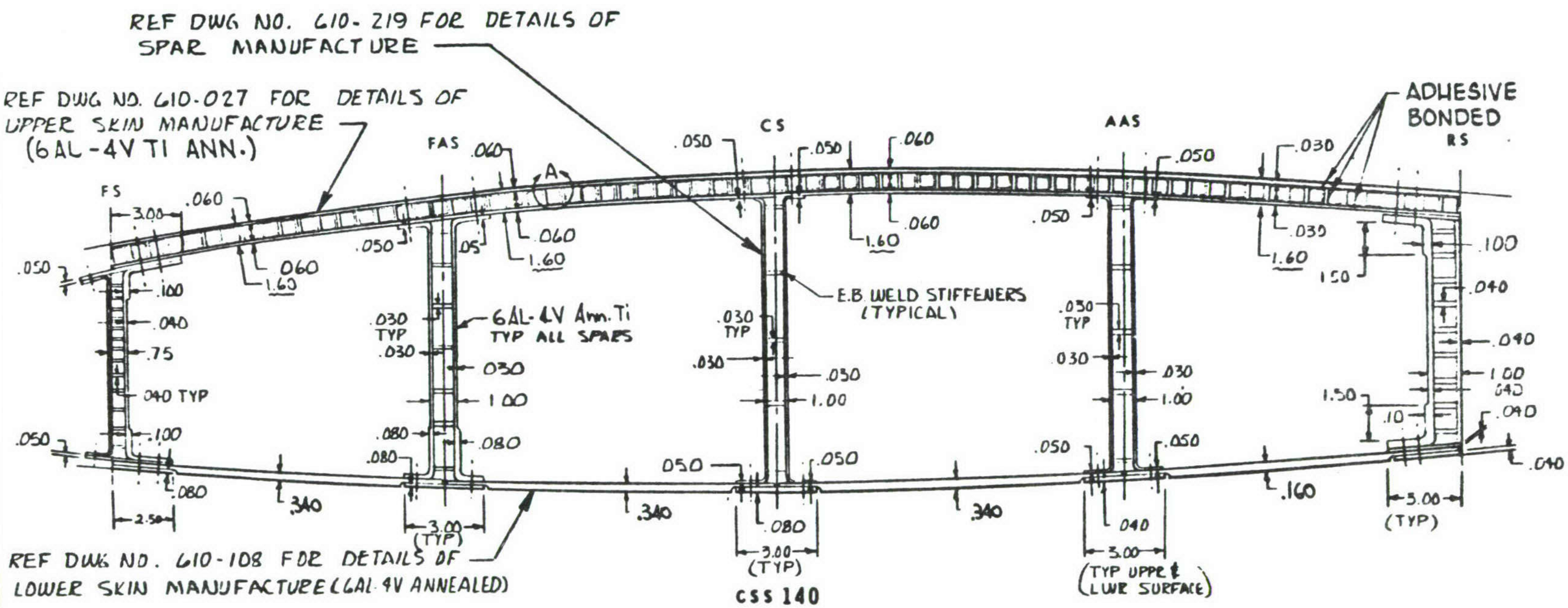


PREPARED BY J D Bixler DATE 8/9/72

GENERAL DYNAMICS
Convair Aerospace Division
Fort Worth Operation

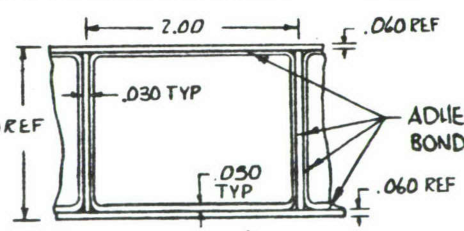
CROSS SECTION CONCEPT 610R-003 A

TITLE WING SECTION - WELDED SPARS, SQ. TUBE UPPER SKIN, PLANK LOWER SKIN.



CSS 140

1/4 Scale



DETAIL A (FULL SCALE)

WEIGHTS FOR 1 INCH OF CROSS SECTION

Part	Stock Wt.	Finished Wt.
Upper Panel & Spar Caps	2.82	2.35
Lower Panel & Spar Caps	4.80	4.00
Spar Webs	.89	.74
	TOTAL	7.09

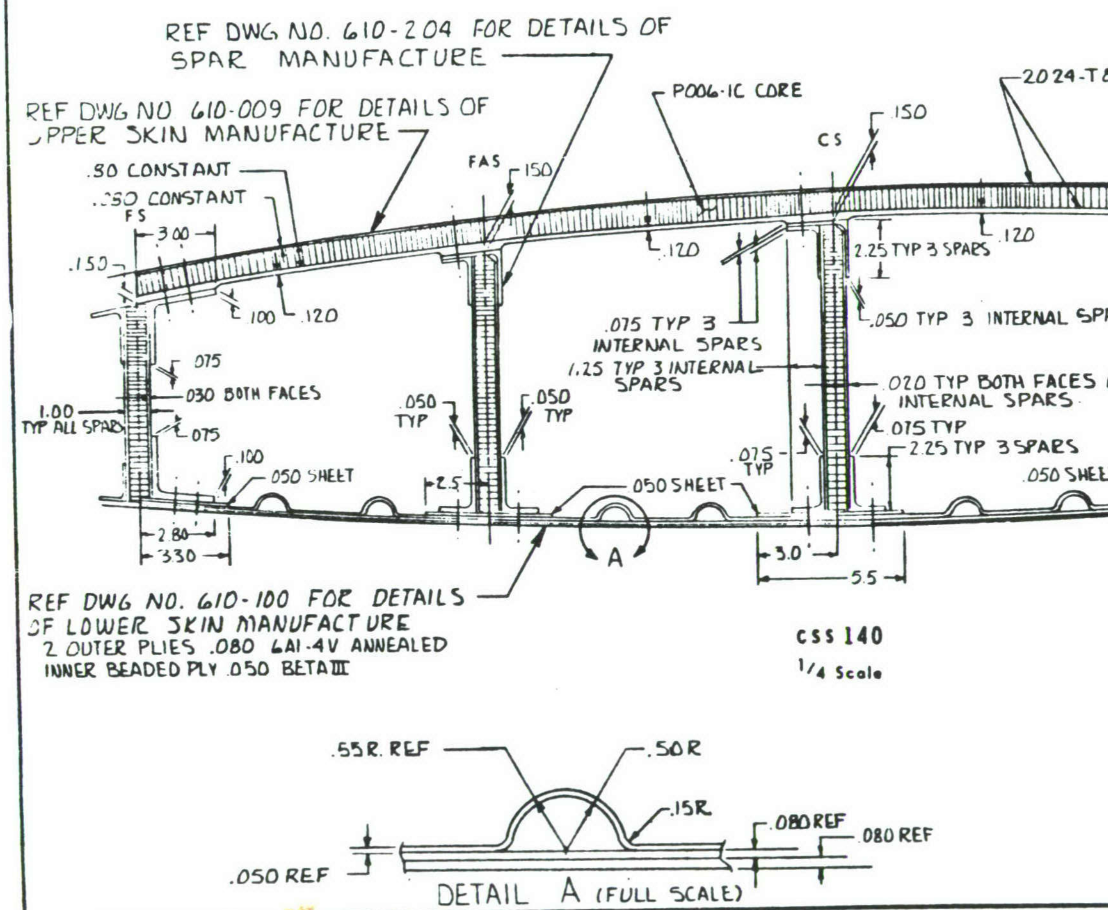
PREPARED BY J. D. Bixler DATE 8/7/72

GENERAL DYNAMICS
Convair Aerospace Division
Fort Worth Operation

CROSS SECTION CONCEPT

610R-004

TITLE WING SECTION ~ SANDWICH SPARS, SIMPLIFIED SANDWICH UPPER SKIN, LAMINATED STIFFENED LOWER SKIN.



PREPARED BY J. D. Bixler

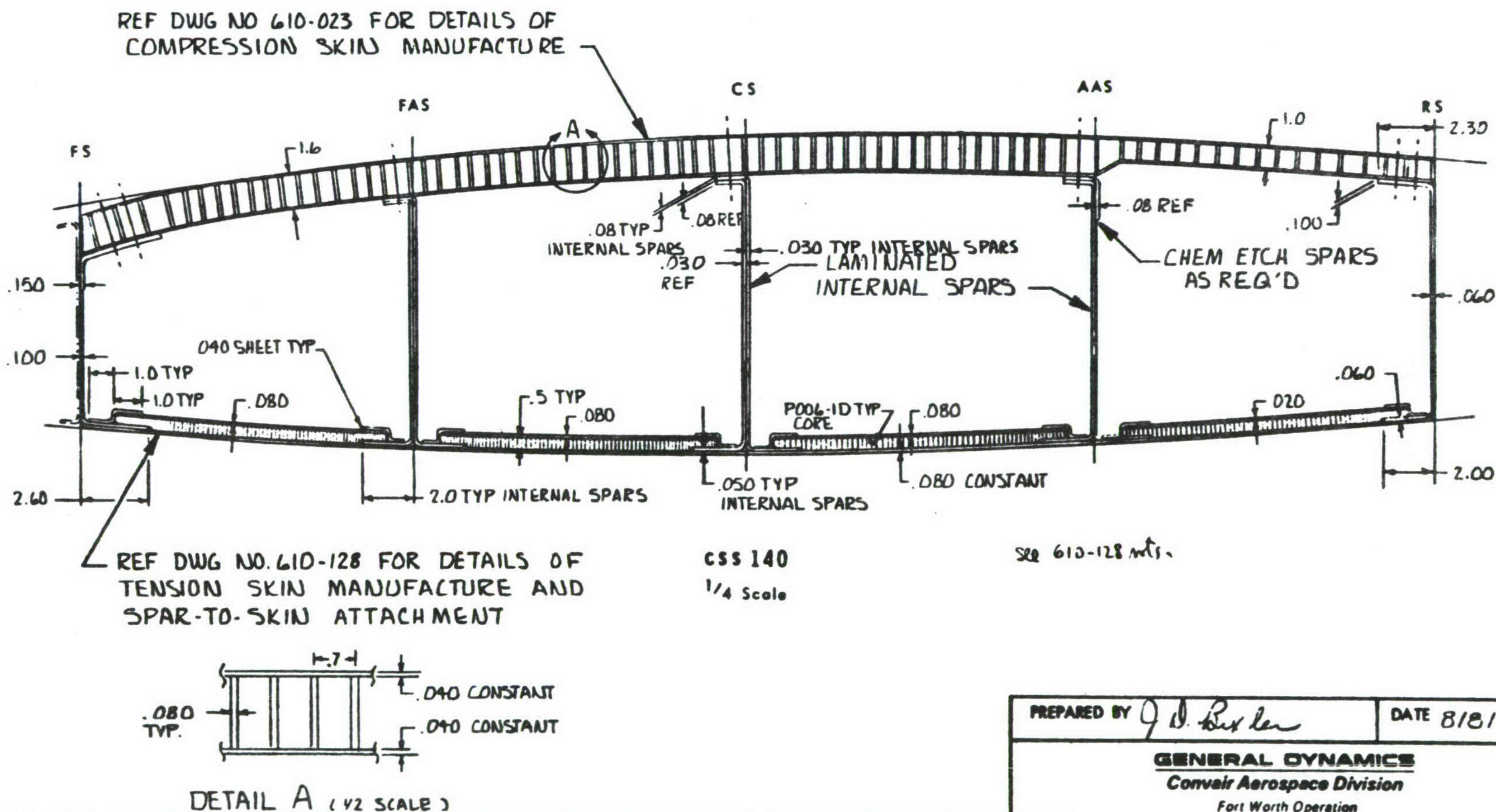
DATE 8/8/72

GENERAL DYNAMICS
Convair Aerospace Division
Fort Worth Operation

ALL SPARS, SKINS, ¢ STIFFENERS BETA III - H1000 Ti

CROSS SECTION CONCEPT	610R-005
TITLE WING SECTION ~ LAMINATED SPARS, WELDED UPPER SKIN, ADHESIVE BONDED SANDWICH LOWER SKIN.	

Change to 88.2.3

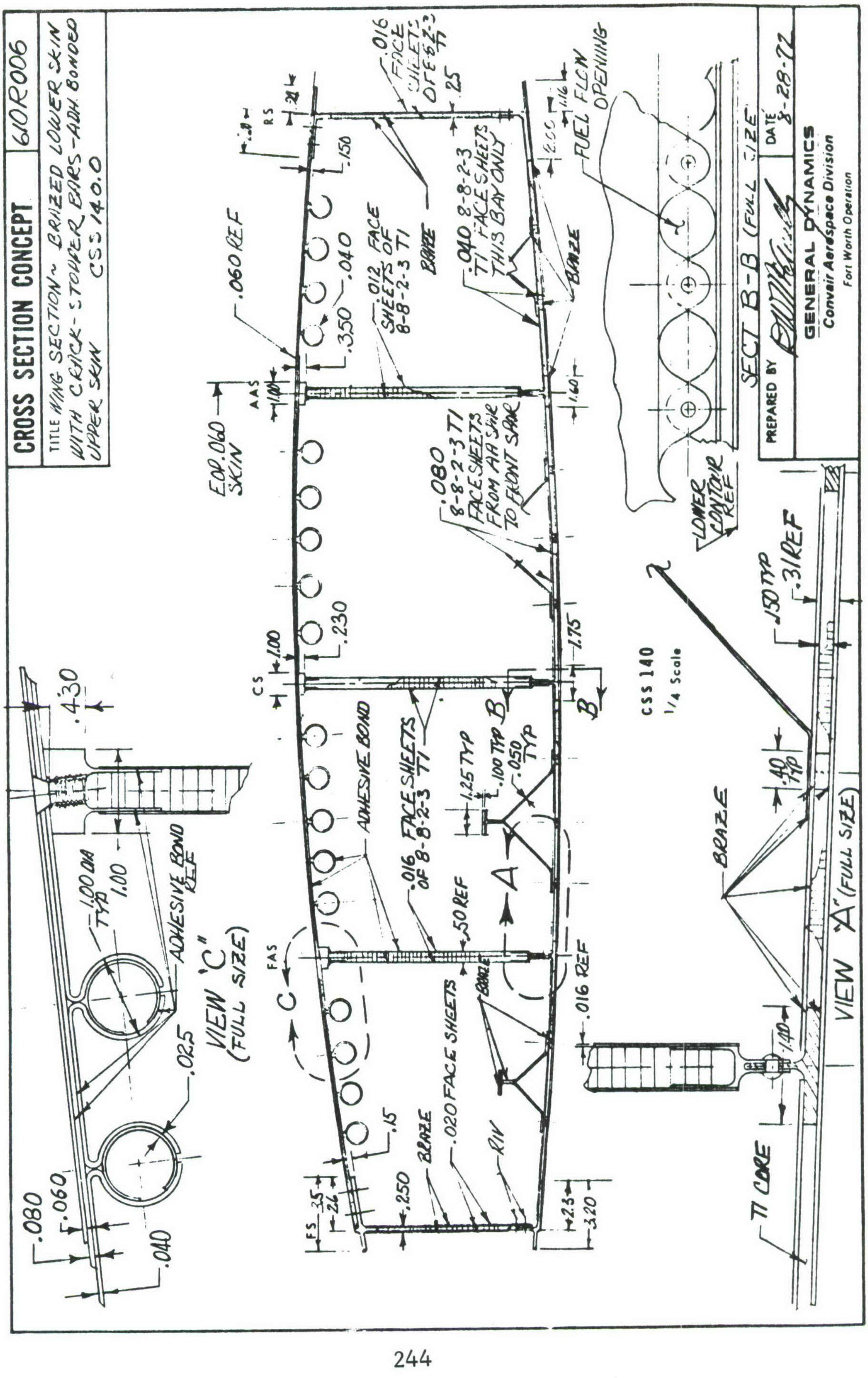


CSS 140

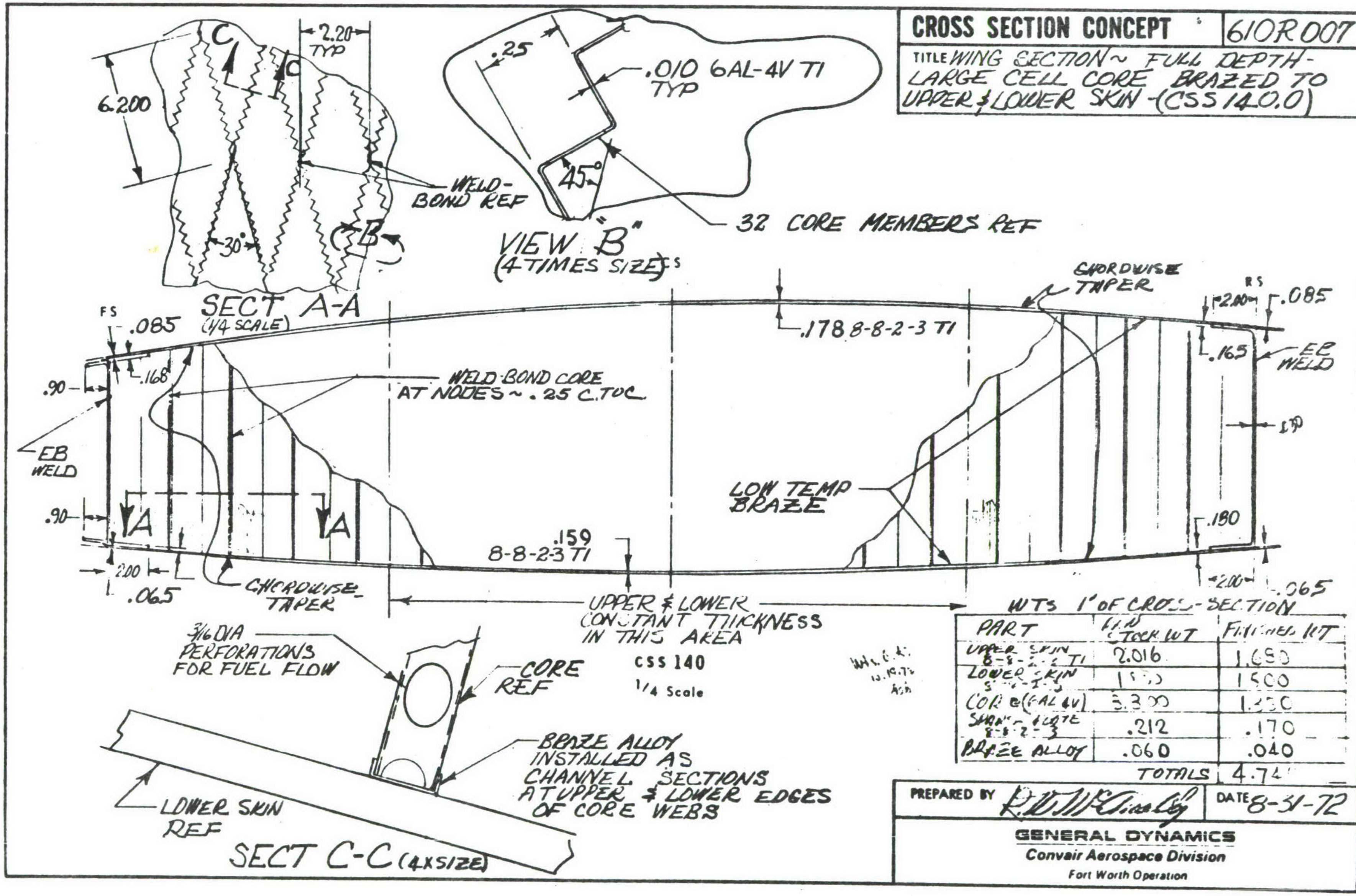
1/4 Scale

See 610-128 mts.

PREPARED BY J. D. Baxley	DATE 8/8/72
GENERAL DYNAMICS Convair Aerospace Division Fort Worth Operation	



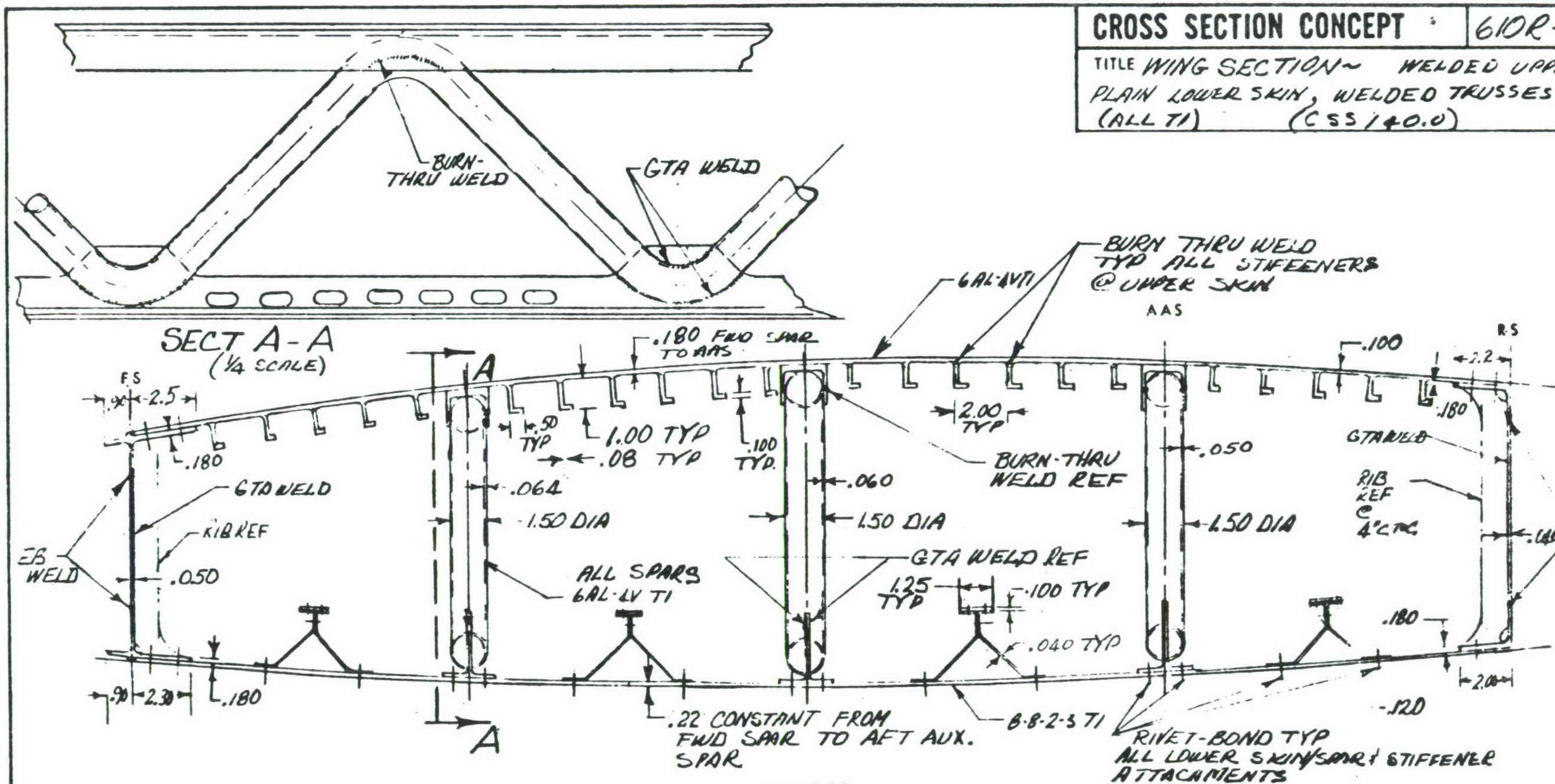
CROSS SECTION CONCEPT
610R006
TITLE WING SECTION ~ BRAZED LOWER SKIN WITH CRACK-STOPPER BARS - ADH. BONDED UPPER SKIN CSS 140.0
PREPARED BY
DATE 8-28-72
GENERAL DYNAMICS
Convair Aerospace Division
Fort Worth Operation
SECT B-B (FULL SIZE)
FUEL FLOW OPENING
LOWER CONTOUR REF
CSS 140
1/4 Scale
VIEW "A" (FULL SIZE)
VIEW "C" (FULL SIZE)
TI CORE
BRAZE
ADHESIVE BOND
ADHESIVE BOND REF
1.00 DIA TYP
.016 FACE SHEETS OF 8-8-2-3 TI
.020 FACE SHEETS
.012 FACE SHEETS OF 8-8-2-3 TI
.080 8-8-2-3 TI FACESHEETS FROM AFT SPAR TO FRONT SPAR
.040 8-8-2-3 TI FACE SHEETS THIS BAY ONLY
EDP .060 SKIN
.060 REF
FACE SHEETS 8-8-2-3 TI



PART	STOCK WT	FINISHED WT
UPPER SKIN 8-8-2-3 TI	2.016	1.690
LOWER SKIN	[illegible]	1.500
CORE (6AL 4V)	3.300	1.330
SHEAR PLATE 8-8-2-3	.212	.170
BRAZE ALLOY	.060	.040
TOTALS		4.74

CROSS SECTION CONCEPT 610R-008

TITLE WING SECTION~ WELDED UPPER SKIN, PLAIN LOWER SKIN, WELDED TRUSSES (ALL TI) (CSS 140.0)

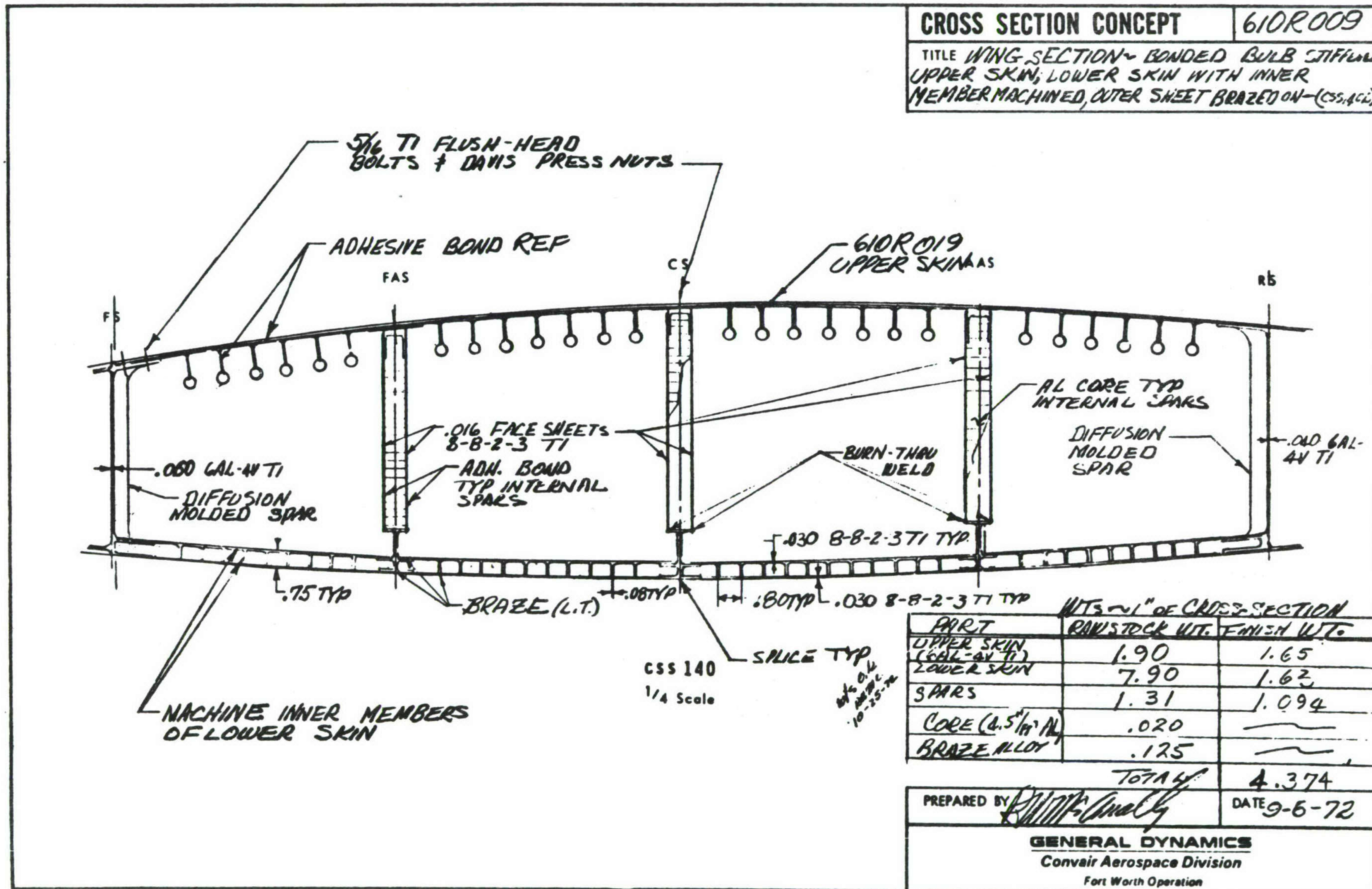


CSS 140

1/4 Scale

PREPARED BY R.W. McAnally DATE 9-5-72

GENERAL DYNAMICS
Convair Aerospace Division
Fort Worth Operation

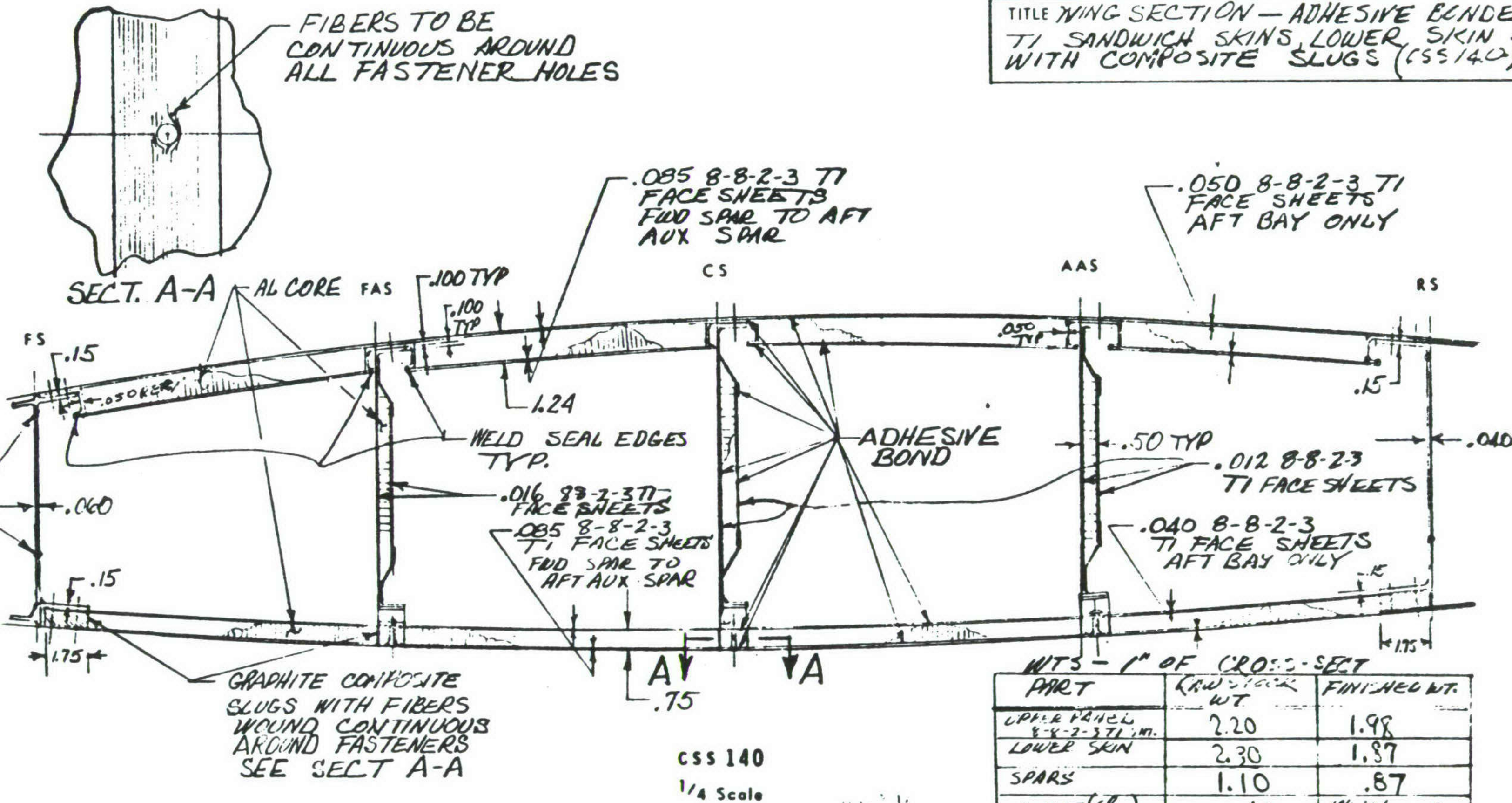


WTS ~ 1" OF CROSS-SECTION

PART	RAWSTOCK WT.	FINISH WT.
UPPER SKIN (6AL-4V TI)	1.90	1.65
LOWER SKIN	7.90	1.62
SPARS	1.31	1.094
CORE (4.5#/ft³ AL)	.020	—
BRAZE ALLOY	.125	—
TOTAL		4.374

CROSS SECTION CONCEPT	610R010
TITLE WING SECTION — ADHESIVE BONDED TI SANDWICH SKINS, LOWER SKIN WITH COMPOSITE SLUGS (CSS 140)	

A



WTS – 1" OF CROSS-SECT

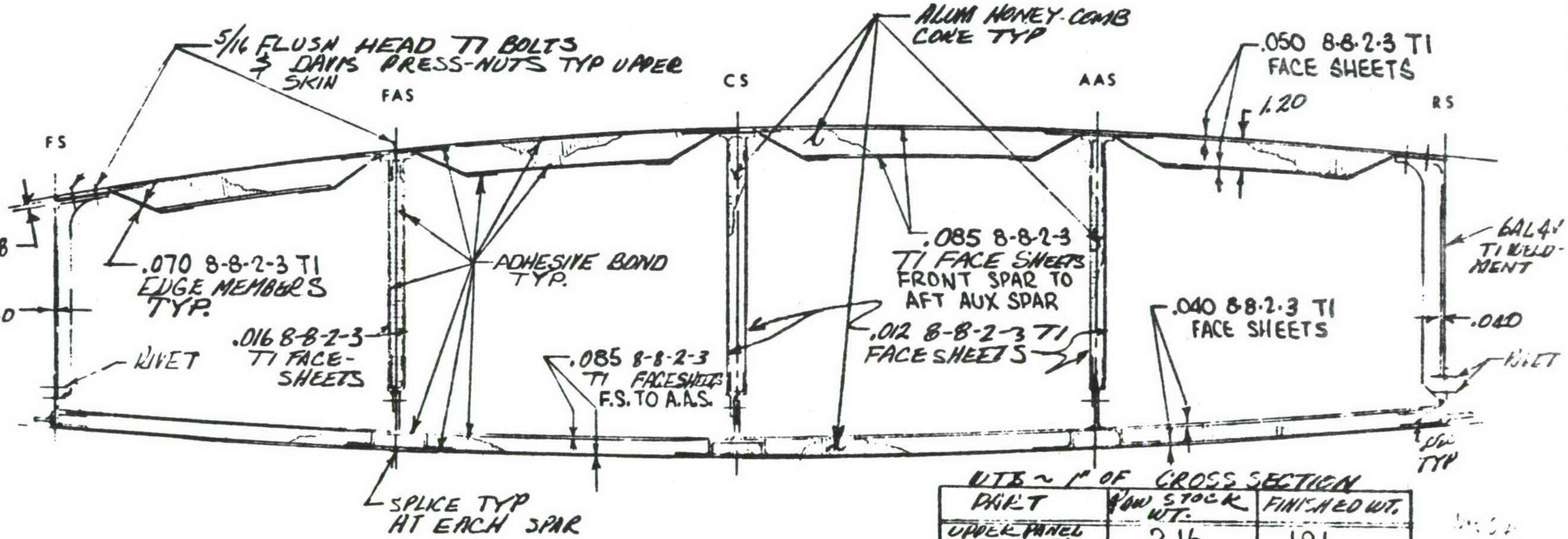
PART	RAW STOCK WT	FINISHED WT.
UPPER PANEL 8-8-2-3 TI in.	2.20	1.98
LOWER SKIN	2.30	1.87
SPARS	1.10	.87
CORE (al.)	.40	[illegible]
GRAPHITE COMP	.30	" – " "
TOTALS		4.72

PREPARED BY [signature]	DATE 9-8-72

GENERAL DYNAMICS
Convair Aerospace Division
Fort Worth Operation

CROSS SECTION CONCEPT 610R011 **A**

TITLE WING SECTION ~ ADHESIVE BONDED SANDWICH UPPER & LOWER SKINS AND INTERNAL SPARS ~ (CSS 140.0)



CSS 140

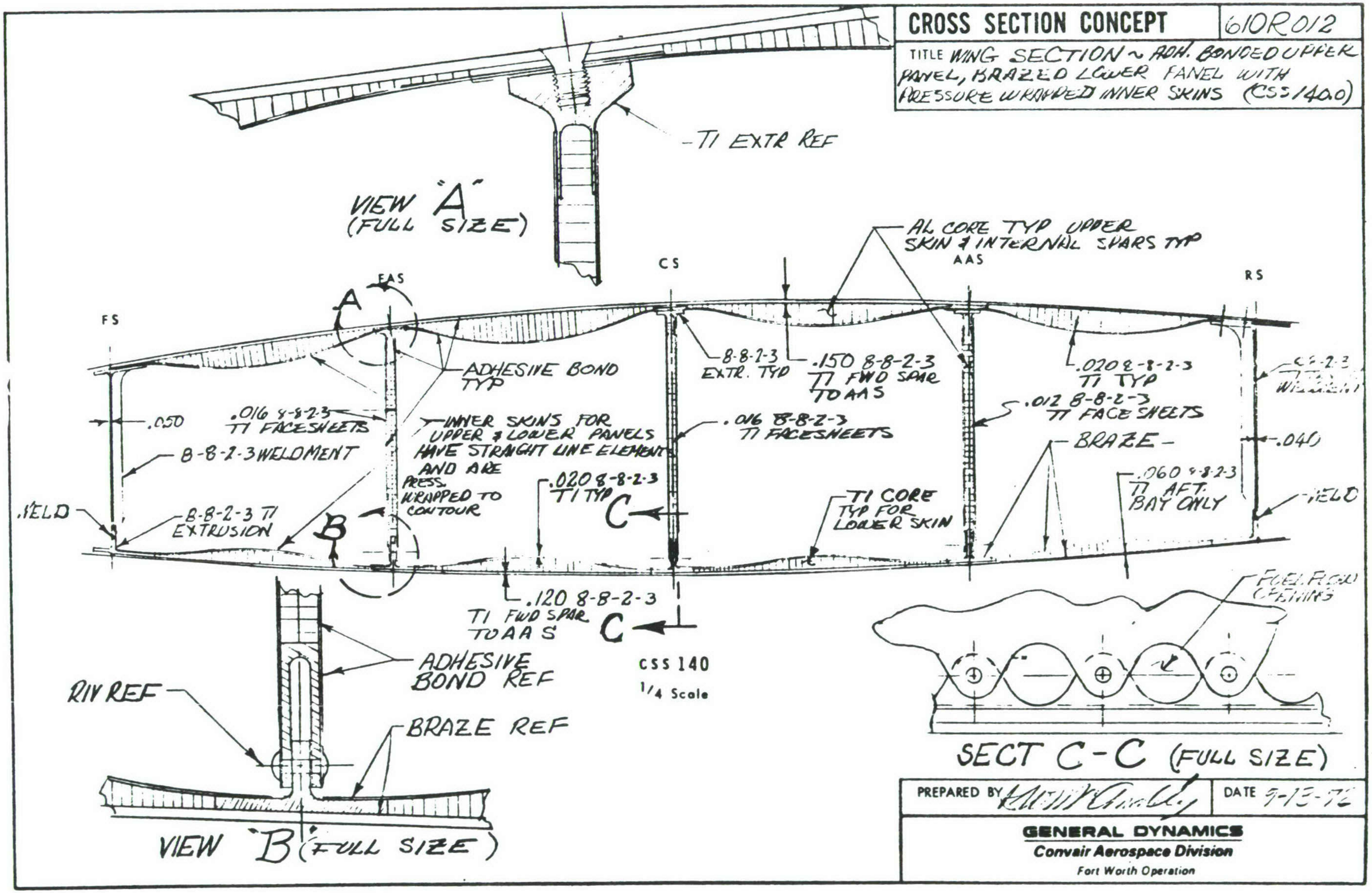
1/4 Scale

WTS ~ 1" OF CROSS SECTION

PART	RAW STOCK WT.	FINISHED WT.
UPPER PANEL 8-8-2-3 TI	2.16	1.91
LOWER SKIN 8-8-2-3 TI	2.09	1.74
SPARS 6AL-4V	.91	.73
CORE	.27	INCLUDED IN ABOVE WTS
TOTALS		4.27

PREPARED BY [signature] DATE 9-11-72

GENERAL DYNAMICS
Convair Aerospace Division
Fort Worth Operation


CROSS SECTION CONCEPT
610R012
TITLE WING SECTION ~ ADH. BONDED UPPER PANEL, BRAZED LOWER PANEL WITH PRESSURE WRAPPED INNER SKINS (CSS 140.0)
-TI EXTR REF
VIEW "A" (FULL SIZE)
AL CORE TYP UPPER SKIN & INTERNAL SPARS TYP
FS
FAS
CS
AAS
RS
A
ADHESIVE BOND TYP
8-8-2-3 EXTR. TYP
.150 8-8-2-3 TI FWD SPAR TO AAS
.020 8-8-2-3 TI TYP
.050
.016 8-8-2-3 TI FACESHEETS
INNER SKINS FOR UPPER & LOWER PANELS HAVE STRAIGHT LINE ELEMENT AND ARE PRESS. WRAPPED TO CONTOUR
.016 8-8-2-3 TI FACESHEETS
.012 8-8-2-3 TI FACE SHEETS
BRAZE
.040
8-8-2-3 WELDMENT
.020 8-8-2-3 TI TYP
.060 8-8-2-3 TI AFT BAY ONLY
WELD
8-8-2-3 TI EXTRUSION
B
C
TI CORE TYP FOR LOWER SKIN
WELD
.120 8-8-2-3 TI FWD SPAR TO AAS
C
FUEL FLOW OPENINGS
CSS 140
1/4 Scale
ADHESIVE BOND REF
RIV REF
BRAZE REF
VIEW "B" (FULL SIZE)
SECT C-C (FULL SIZE)
PREPARED BY
DATE 9-13-72
GENERAL DYNAMICS
Convair Aerospace Division
Fort Worth Operation

CROSS SECTION CONCEPT

610R-013B

TITLE WING SECTION-LAMINATED LOWER SKIN WITH STEPPED SPAR CAPS, HAT STIFF. UPR. SKIN

SPAR ELEMENT NUMBER	10	12	14		16		18
DOUBLER* NUMBER	-	A	B	C	D	E	F
DOUBLER SIZE	-	.375 × 1.00	.500 × 1.25		.573 × 1.50		.770 × 1.00

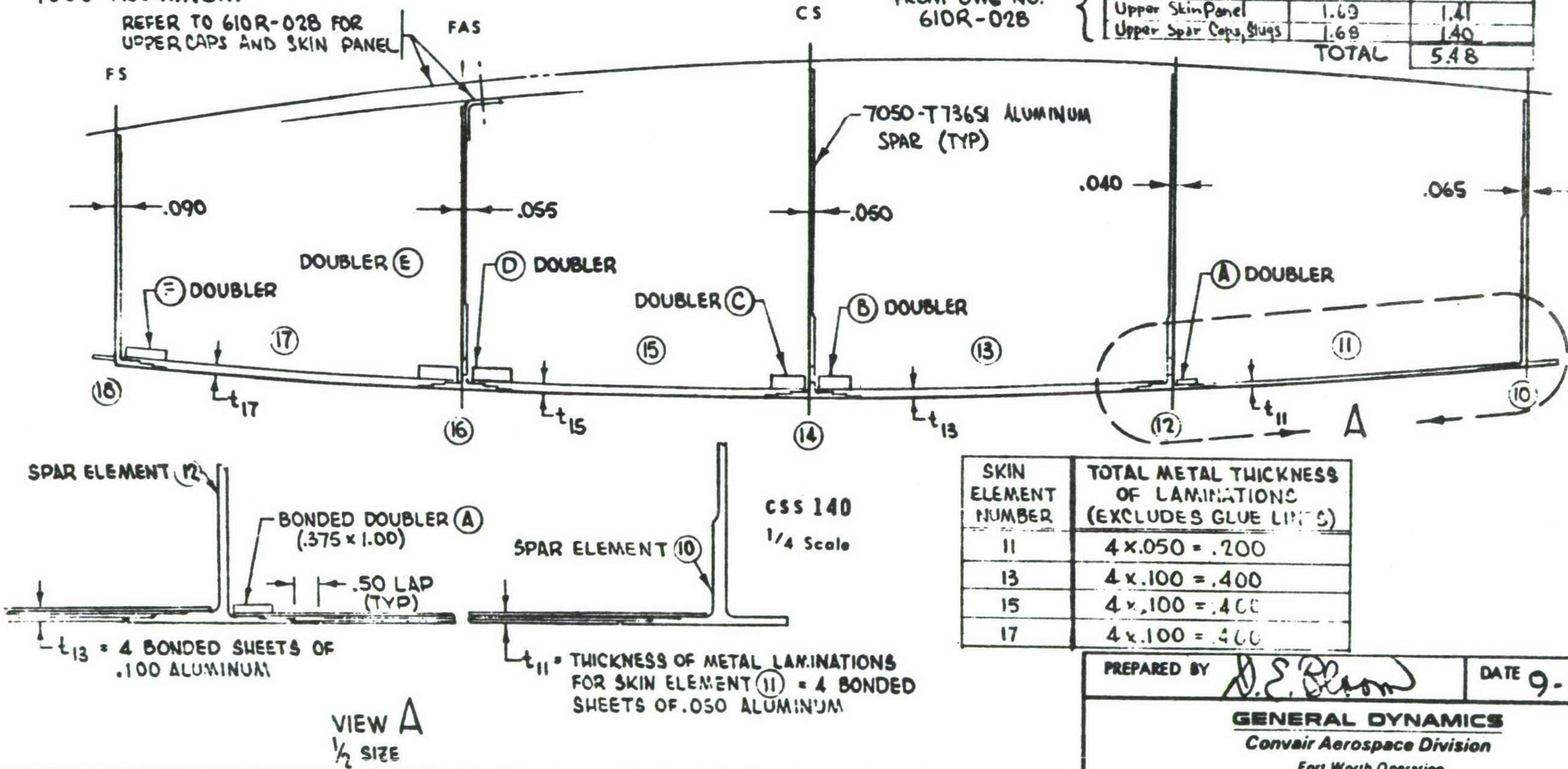
*NOTE: SPAR ELEMENTS 12,14,16 & 18 REQUIRE CROSS SECTIONAL AREA IN ADDITION TO THAT PROVIDED BY THE STEPPED SPAR CAPS (ON THE LOWER SURFACE). THE METHOD SHOWN TO PROVIDE THAT AREA CONSISTS OF BONDED DOUBLERS. ALTERNATE METHOD WOULD BE A THICKENED LAND IN THE SPAR WEB AT THE LOWER SURFACE.

WEIGHTS OF 1 INCH OF CROSS SECTION

PART	Stock Wts.	Finished Wts.
Lwr. Skin Panel and Stepped Spar Caps	2.26	1.88
Doublers	.50	.42
Spar Webs	.36	.30
Fasteners	—	.07
Upper Skin Panel	1.69	1.41
Upper Spar Caps, Slugs	1.68	1.40
TOTAL		5.48

FROM DWG NO. 610R-028

LOWER SKIN MATERIAL AND DOUBLERS* ARE 7050 ALUMINUM



CSS 140
1/4 Scale

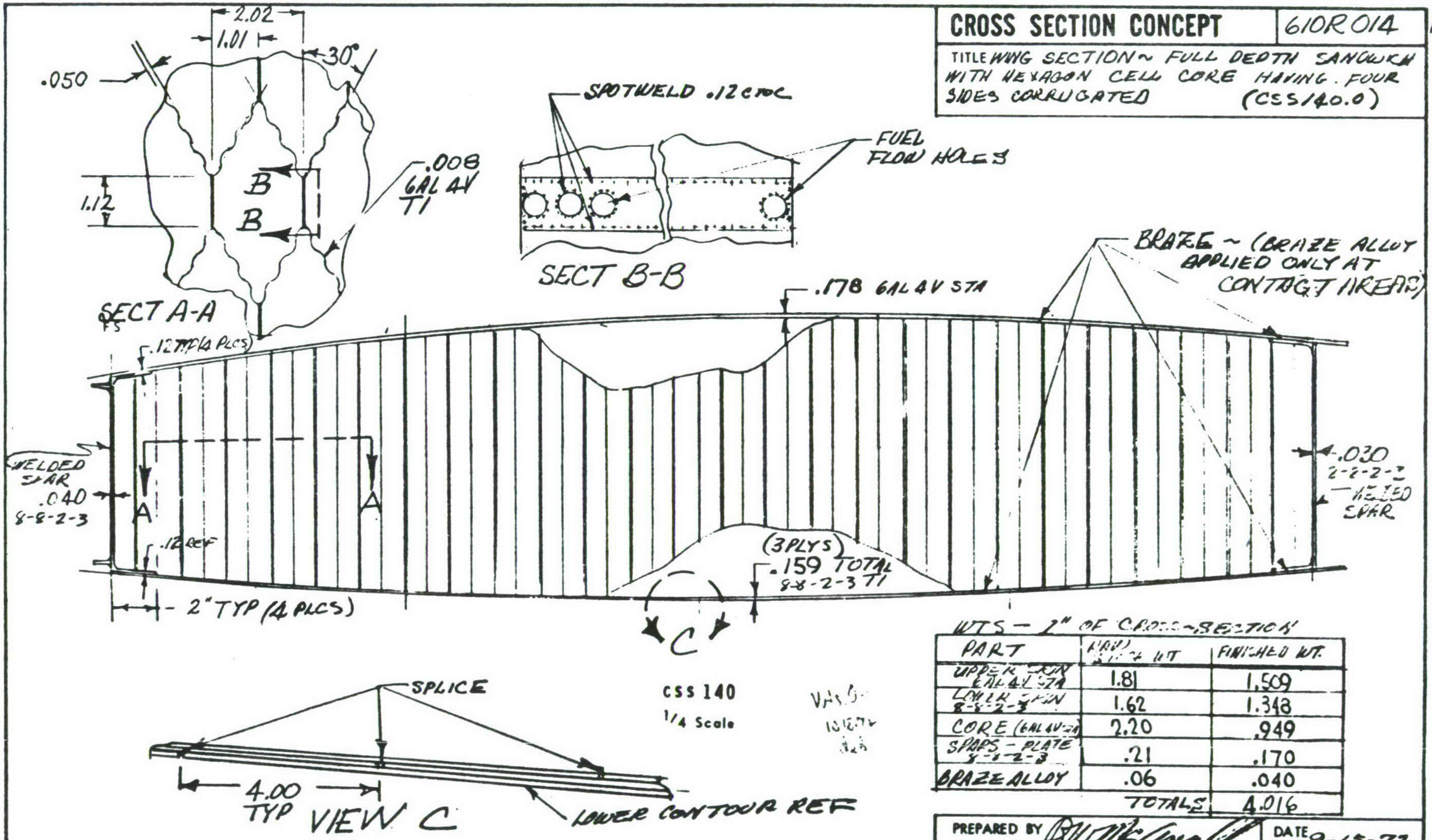
SKIN ELEMENT NUMBER	TOTAL METAL THICKNESS OF LAMINATIONS (EXCLUDES GLUE LINES)
11	4 × .050 = .200
13	4 × .100 = .400
15	4 × .100 = .400
17	4 × .100 = .400

PREPARED BY D. E. Bloom DATE 9-14-72

GENERAL DYNAMICS
Convair Aerospace Division
Fort Worth Operation

CROSS SECTION CONCEPT — 610R014 — A

TITLE WING SECTION ~ FULL DEPTH SANDWICH WITH HEXAGON CELL CORE HAVING FOUR SIDES CORRUGATED (CSS140.0)

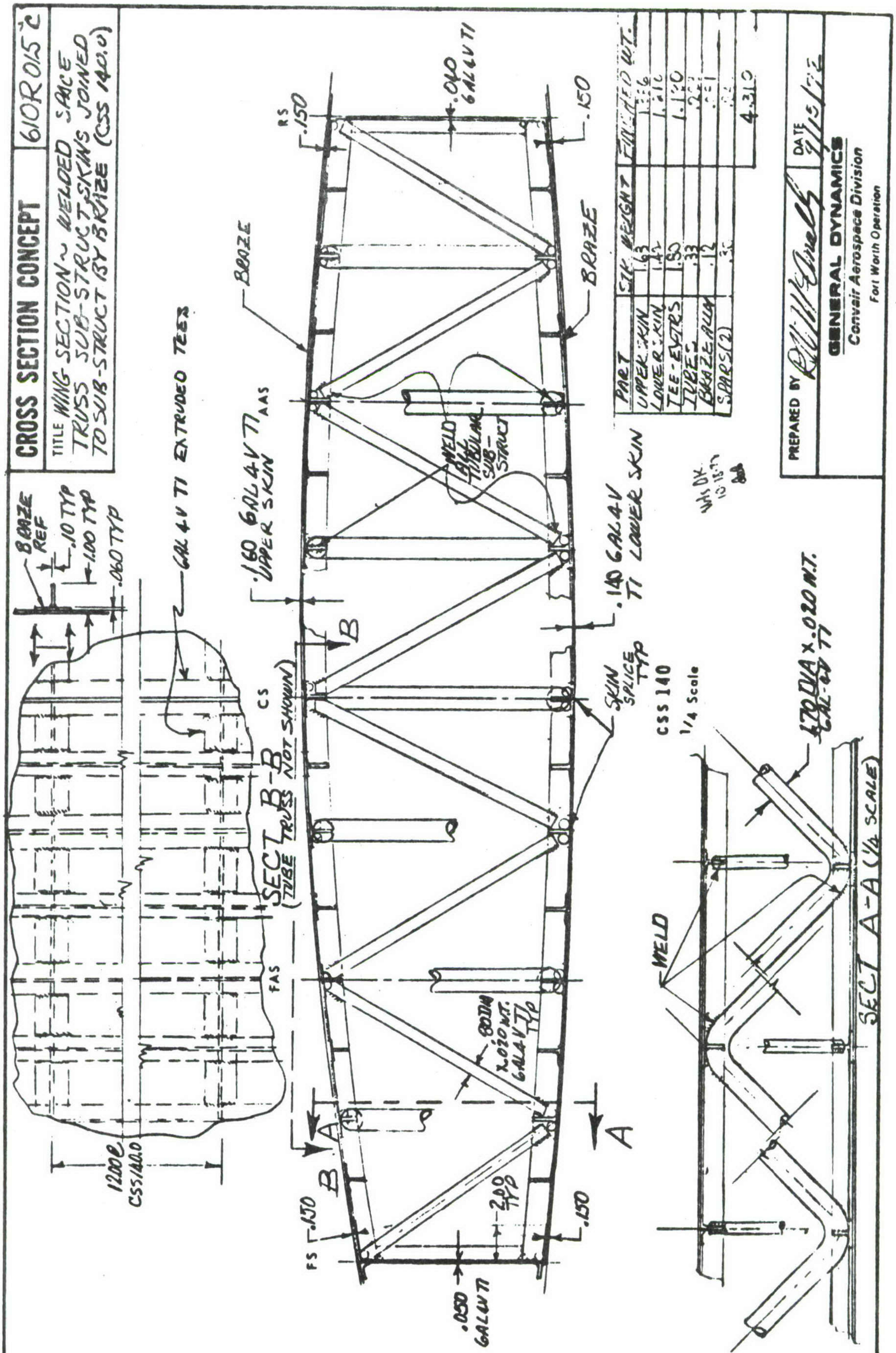


WTS – 2" OF CROSS-SECTION

PART	RAW STOCK WT	FINISHED WT.
UPPER SKIN 6AL 4V STA	1.81	1.509
LOWER SKIN 8-8-2-3	1.62	1.348
CORE (6AL 4V STA)	2.20	.949
SPARS – PLATE 8-8-2-3	.21	.170
BRAZE ALLOY	.06	.040
	TOTALS	4.016

PREPARED BY R.W. McAnally DATE 9-15-72

GENERAL DYNAMICS
Convair Aerospace Division
Fort Worth Operation

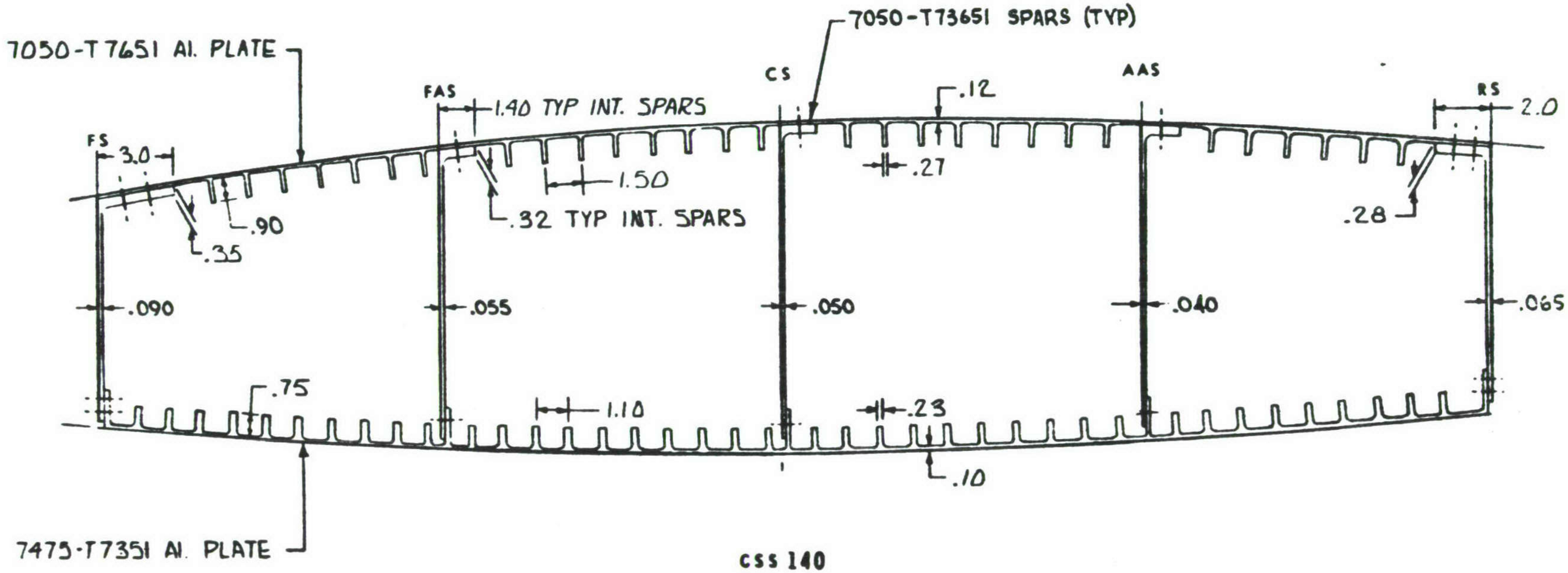

CROSS SECTION CONCEPT
610R015 C
TITLE WING SECTION ~ WELDED SPACE TRUSS SUB-STRUCT & SKINS JOINED TO SUB-STRUCT BY BRAZE (CSS 140.0)
BRAZE
.160 6AL4V UPPER SKIN
.140 6AL4V TI LOWER SKIN
6AL4V TI EXTRUDED TEES
SECT B-B (TUBE TRUSS NOT SHOWN)
SKIN SPLICE TYP
CSS 140
1/4 Scale
WELD
SECT A-A (1/4 SCALE)
PREPARED BY
DATE
GENERAL DYNAMICS
Convair Aerospace Division
Fort Worth Operation

CROSS SECTION CONCEPT	610R-016A
TITLE WING SECTION - ALUMINUM INTEGRALLY STIFFENED SKIN PANELS, MACHINED	

WTS. FOR 1 INCH OF CROSS SECTION

PART	Stock Wt.	Finished Wt.
Upper Skin	6.0	2.370
Lower Skin	4.8	2.440
Spars	10.2	.800
	TOTAL	5.610

(SPAR CAPS WT. IN SKIN)



CSS 140
1/4 Scale

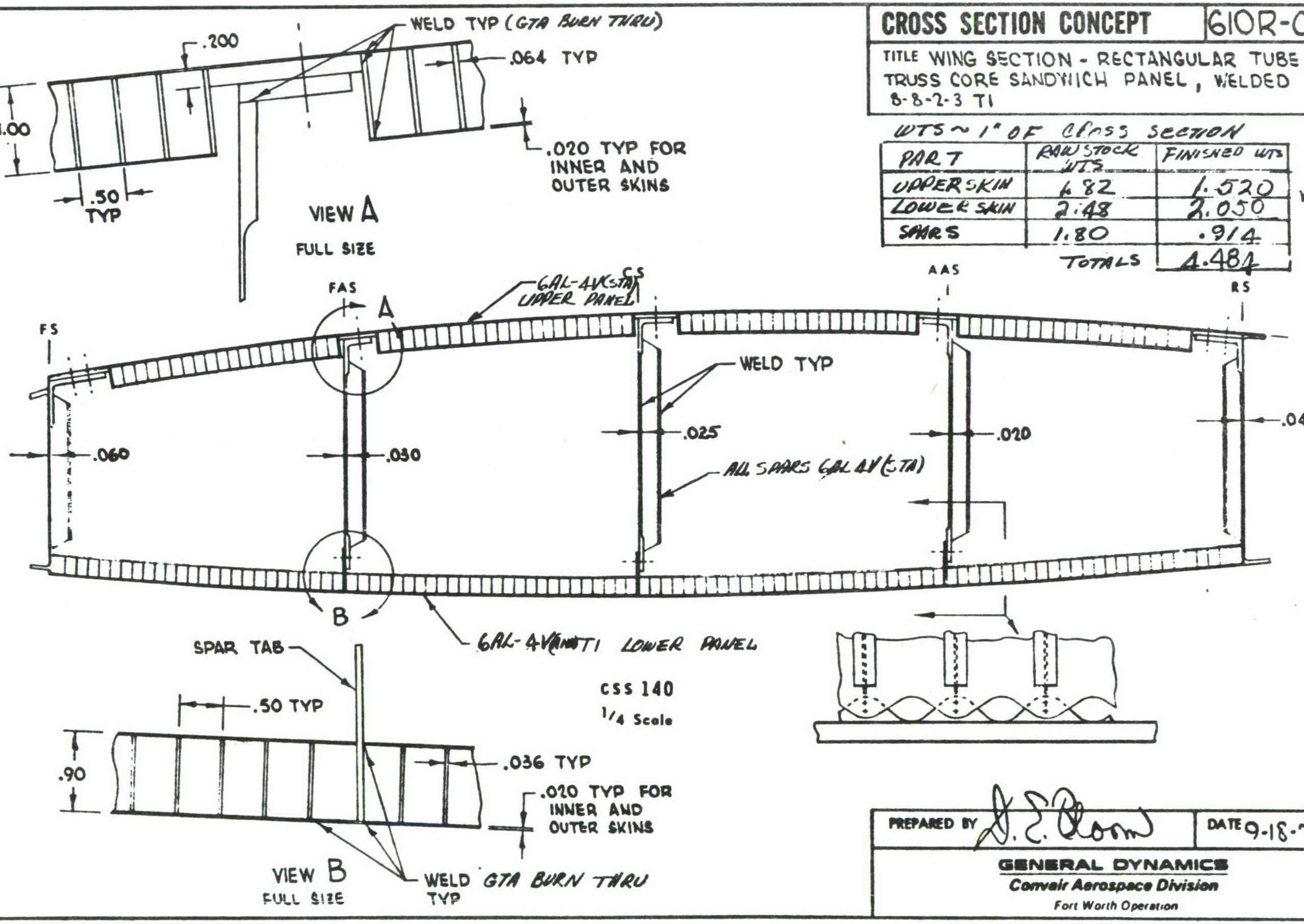
PREPARED BY	DATE 9/13/72
GENERAL DYNAMICS Convair Aerospace Division Fort Worth Operation	

CROSS SECTION CONCEPT | 610R-017A

TITLE WING SECTION - RECTANGULAR TUBE TRUSS CORE SANDWICH PANEL, WELDED 8-8-2-3 TI

WTS ~ 1" OF CROSS SECTION

PART	RAW STOCK WTS	FINISHED WTS
UPPER SKIN	4.82	1.520
LOWER SKIN	2.48	2.050
SPARS	1.80	.914
	TOTALS	4.484



PREPARED BY J. E. Boon | DATE 9-18-72

GENERAL DYNAMICS
Convair Aerospace Division
Fort Worth Operation

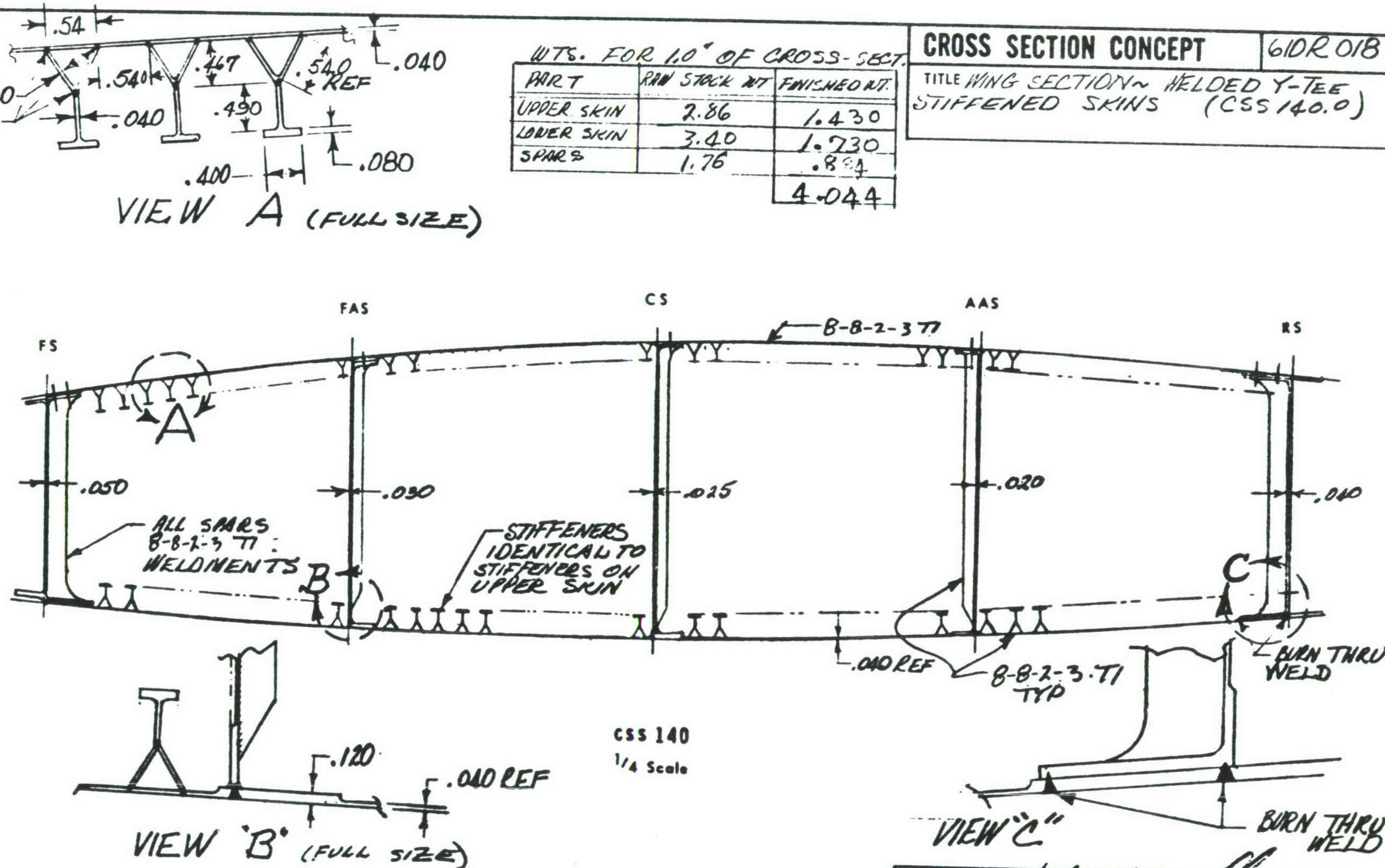
CROSS SECTION CONCEPT

61DR 018

TITLE WING SECTION ~ WELDED Y-TEE STIFFENED SKINS (CSS 140.0)

WTS. FOR 1.0" OF CROSS-SECT.

PART	RAW STOCK WT	FINISHED WT.
UPPER SKIN	2.86	1.430
LOWER SKIN	3.40	1.730
SPARS	1.76	.884
		4.044



PREPARED BY [illegible] DATE 9-18-72

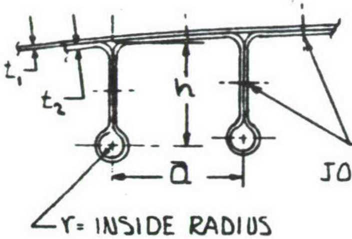
GENERAL DYNAMICS
Convair Aerospace Division
Fort Worth Operation

CROSS SECTION CONCEPT

610R-019 A

TITLE WING SECTION ~ INTEGRAL FORMED BULBED TEE

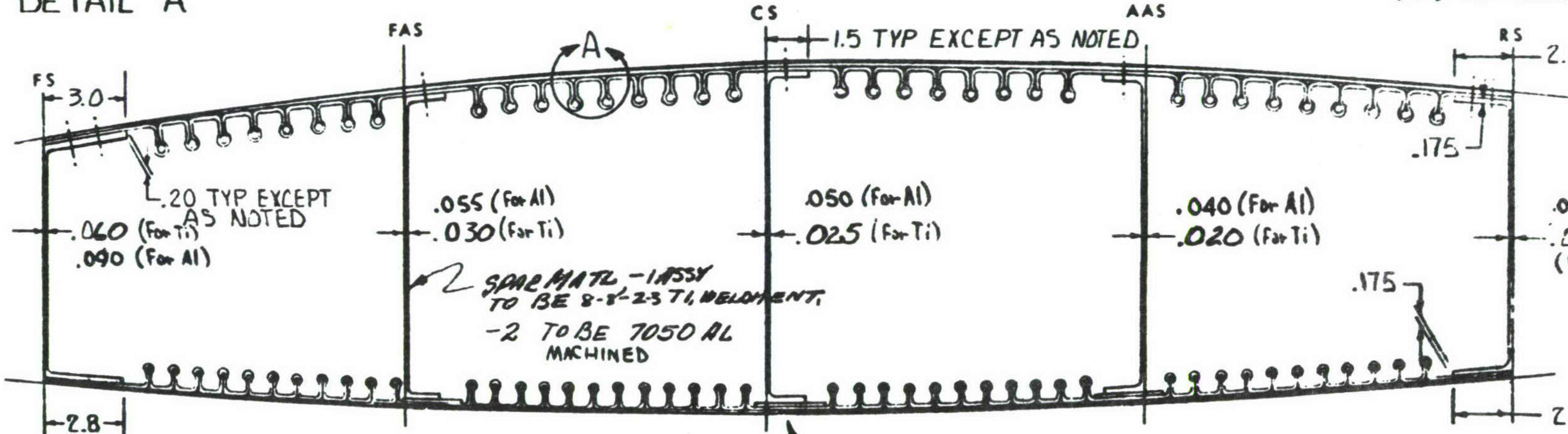
NOTE: THIS CONFIGURATION MAY BE USED OUTBOARD OF CSS 140; REFER TO DWG. NO. 610R120



FOR VALUES OF t, r, a, AND h, SEE TABLE I BELOW.

DETAIL A

PART	RAW STOCK WTS. -1 (Ti)	RAW STOCK WTS. -2 (AL)	FINISHED WTS. -1 (Ti)	FINISHED WTS. -2 (AL)
UPPER SKIN	1.93	2.36	1.400	1.970
LOWER SKIN	2.00	2.74	1.390	2.200
SPARS	2.70	11.25	1.240	1.720
			4.030	5.890



CSS 140
1/4 Scale

TABLE I - DIMENSIONS

Dash No	Material	TENSION SKIN (Lower Surface) t_1	t_2	h	a	r	*COMPRESSION SKIN (Upper Surface) t_1	t_2	h	a	r
-1	* 6AL-4V (STA) 8-8-2-3 Ti	.025	.025	.72	.90	.075	.032	.032	.93	1.16	.096
-2	7050 Aluminum	.080	.045	1.60	1.60	.218	.100	.050	1.60	1.60	.218

TABLE II - JOINING METHODS

METHOD	DESCRIPTION
A	RIVET
B	ADHESIVE BOND
C	WELD
D	BRAZE

PREPARED BY J. D. [illegible] DATE 9/19/72

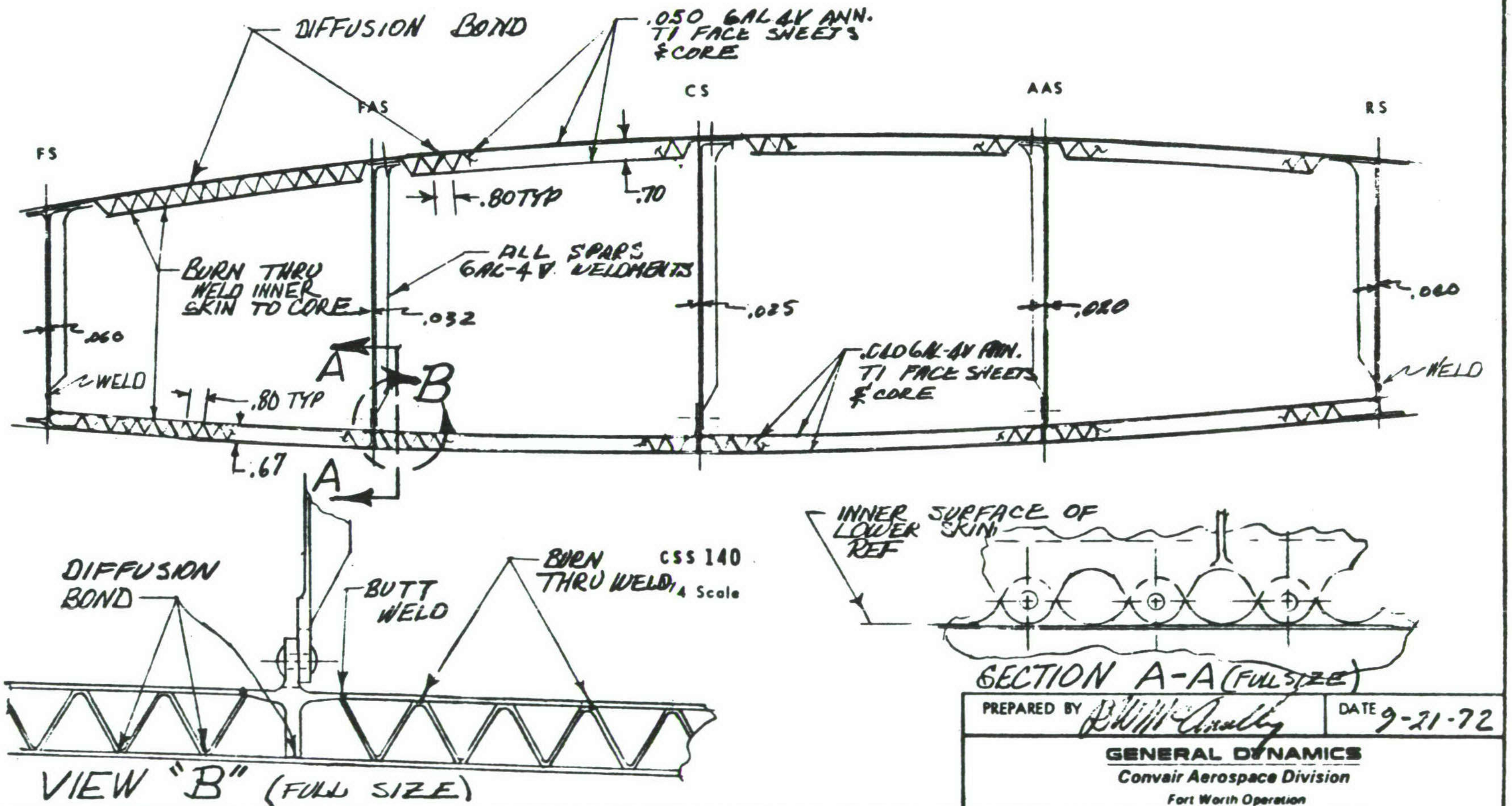
GENERAL DYNAMICS
Convair Aerospace Division
Fort Worth Operation

CROSS SECTION CONCEPT 610R020A

TITLE WING SECTION ~ SANDWICH WITH TRUSS MEMBER CORE - (CSS 140.0)

WTS FOR 1" OF CROSS-SECTION

PART	RAW STOCK WEIGHT	FINISHED WT.
UPPER SKIN (6AL-4V ANN)	1.62	1.350
LOWER SKIN (6AL-4V ANN)	2.48	2.060
SPARS (6AL-4V)	1.70	.854
		4.264



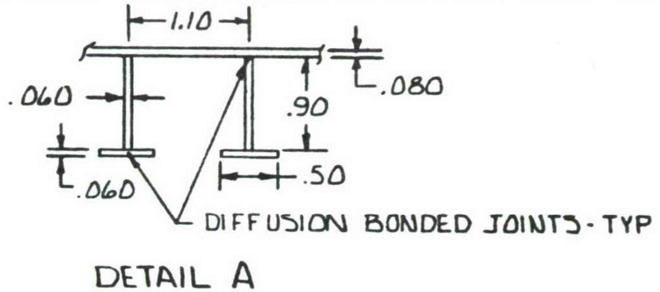
PREPARED BY [signature] DATE 9-21-72

GENERAL DYNAMICS
Convair Aerospace Division
Fort Worth Operation

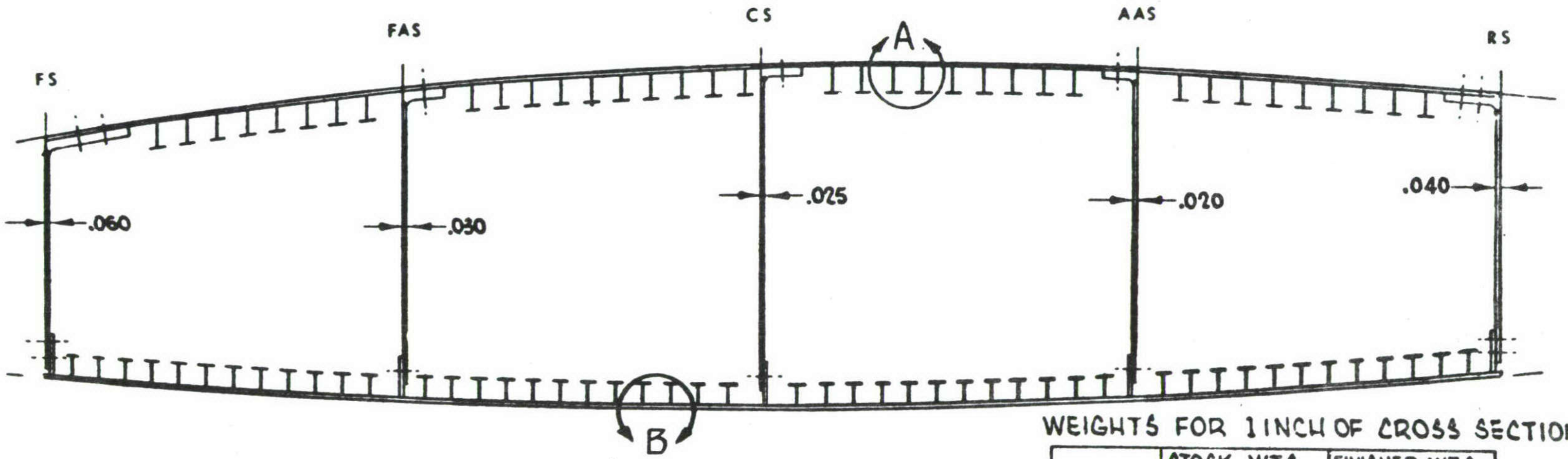
CROSS SECTION CONCEPT

610R-021

TITLE WING SECTION - DIFFUSION BONDED/ TEE STIFFENED PANELS

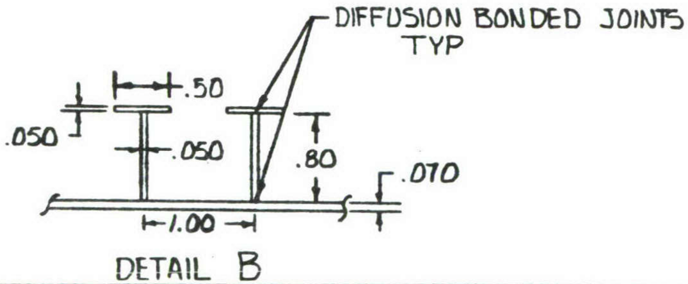


Dash No	MATERIAL (All Titanium)			METHOD OF FABRICATION
	Upper Skin	Lower Skin	Spars	
-1	6Al-4V STA	8-8-2-3	6Al-4V STA	Weld
-2	6Al-4V Annealed	6Al-4V Annealed	6Al-4V STA	Weld or Diffusion Bond & Braze



CSS 140

1/4 Scale



WEIGHTS FOR 1 INCH OF CROSS SECTION

PART	STOCK WTS.		FINISHED WTS.	
	-1	-2	-1	-2
Upper Skin	1.70	2.00	1.420	1.63
Lower Skin	2.10	2.50	1.730	2.05
Spars	1.74	1.92	.874	.964
		TOTALS	4.024	4.644

PREPARED BY J. D. Bixler

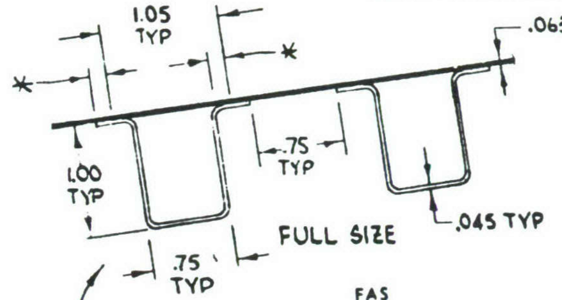
DATE 9/21/72

GENERAL DYNAMICS
Convair Aerospace Division
Fort Worth Operation

CROSS SECTION CONCEPT — 610R-022 A

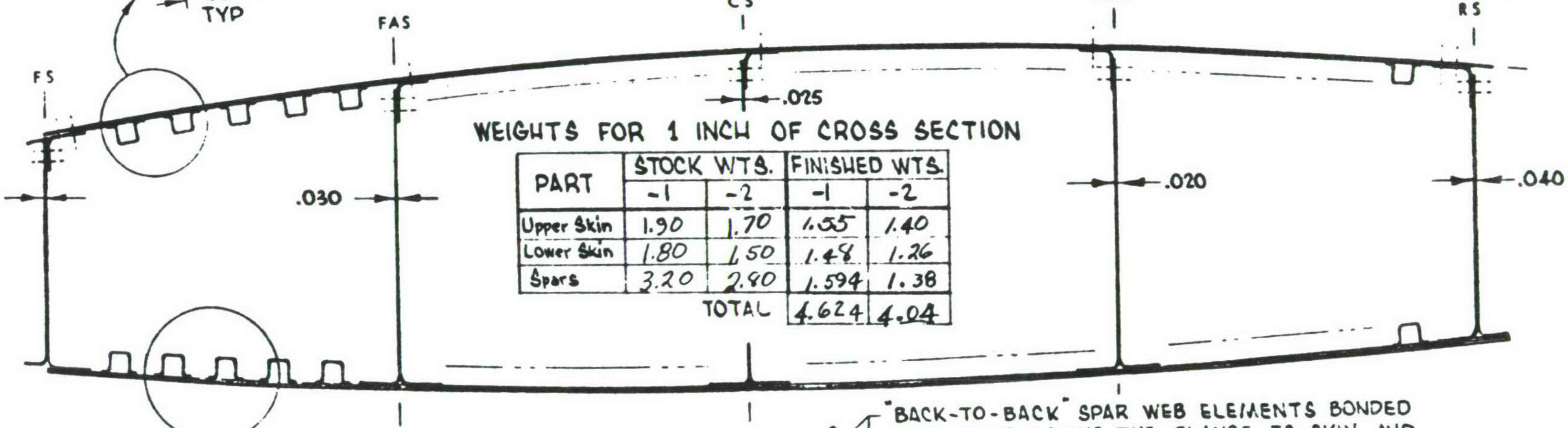
TITLE WING SECTION - ADHESIVE BONDED LAMINATED SKINS WITH BONDED HAT STIFFENERS, TITANIUM

* = VARIES FROM .15 TO .30, DEPENDING UPON FABRICATION METHOD



Dash No	MATERIAL (All Titanium)			METHOD OF FABRICATION
	Upper Skin*	Lower Skin*	Spars*	
-1	6Al-4V Annealed	6Al-4V Annealed	6Al-4V STA	Weld, Braze, Diffusion Bond and (for upper surface only) Rivet
-2	6Al-4V STA	8-8-2-3	6Al-4V STA	

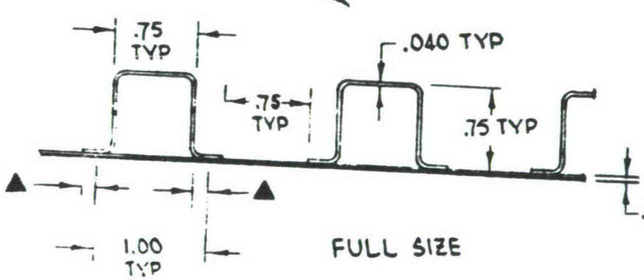
* Monolithic or Laminated (2 Sheets)

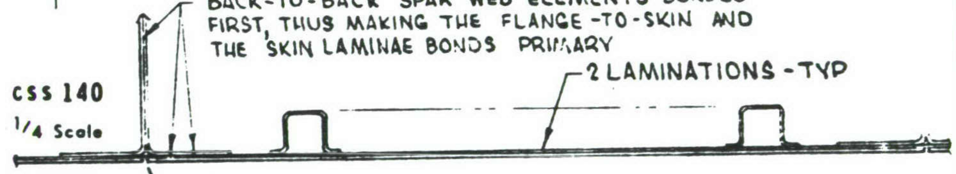


WEIGHTS FOR 1 INCH OF CROSS SECTION

PART	STOCK WTS. -1	STOCK WTS. -2	FINISHED WTS. -1	FINISHED WTS. -2
Upper Skin	1.90	1.70	1.55	1.40
Lower Skin	1.80	1.50	1.48	1.26
Spars	3.20	2.80	1.594	1.38
		TOTAL	4.624	4.04

▲ = VARIES FROM .13 TO .25, DEPENDING UPON FABRICATION METHOD





PREPARED BY D. E. Bloom — DATE 9-21-72

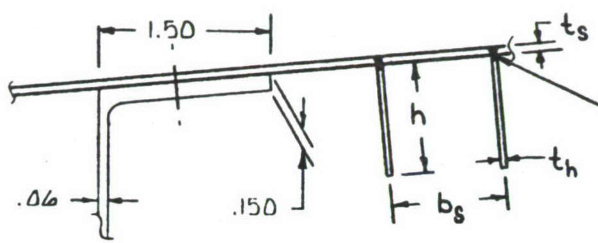
GENERAL DYNAMICS
Convair Aerospace Division
Fort Worth Operation

CROSS SECTION CONCEPT

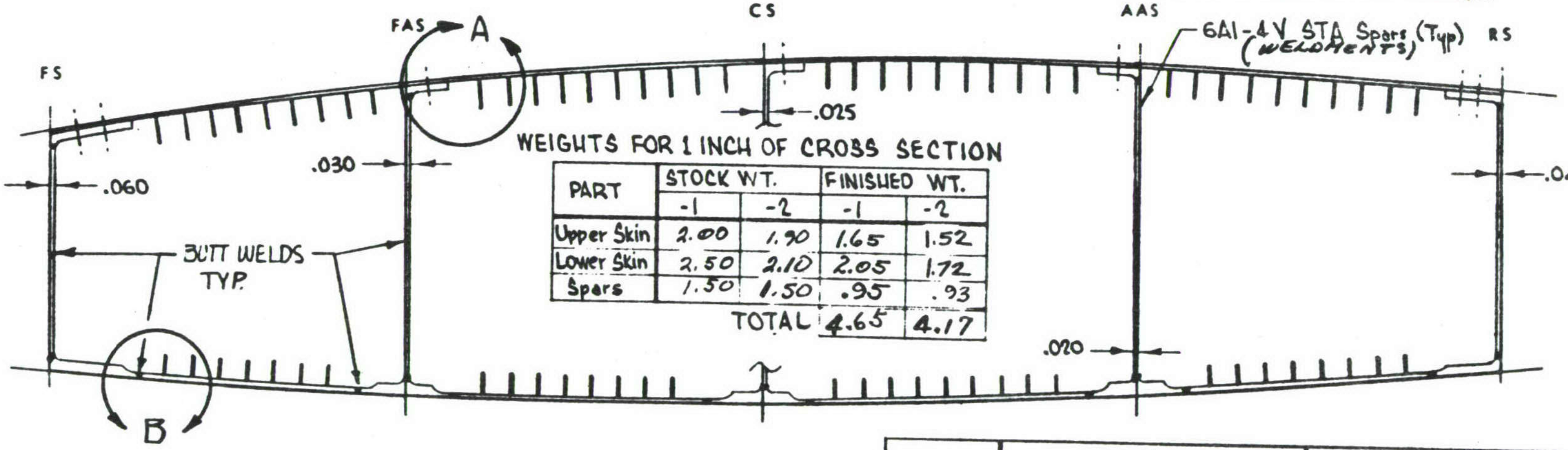
610R-023

TITLE WING SECTION ~ MONOLITHIC / WELDED STIFFENER, INTEGRAL SPAR CAPS

Dash Nº	MATERIAL (All Titanium) Upper Surface	Lower Surface	JOINING METHODS
-1	6Al-4V Ann.	6Al-4V Ann.	Weld or Diffusion Bond
-2	6Al-4V STA	8·8·2·3	Weld



DETAIL A



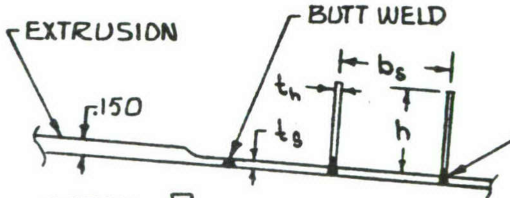
WEIGHTS FOR 1 INCH OF CROSS SECTION

PART	STOCK WT. -1	STOCK WT. -2	FINISHED WT. -1	FINISHED WT. -2
Upper Skin	2.00	1.90	1.65	1.52
Lower Skin	2.50	2.10	2.05	1.72
Spars	1.50	1.50	.95	.93
		TOTAL	4.65	4.17

CSS 140

1/4 Scale

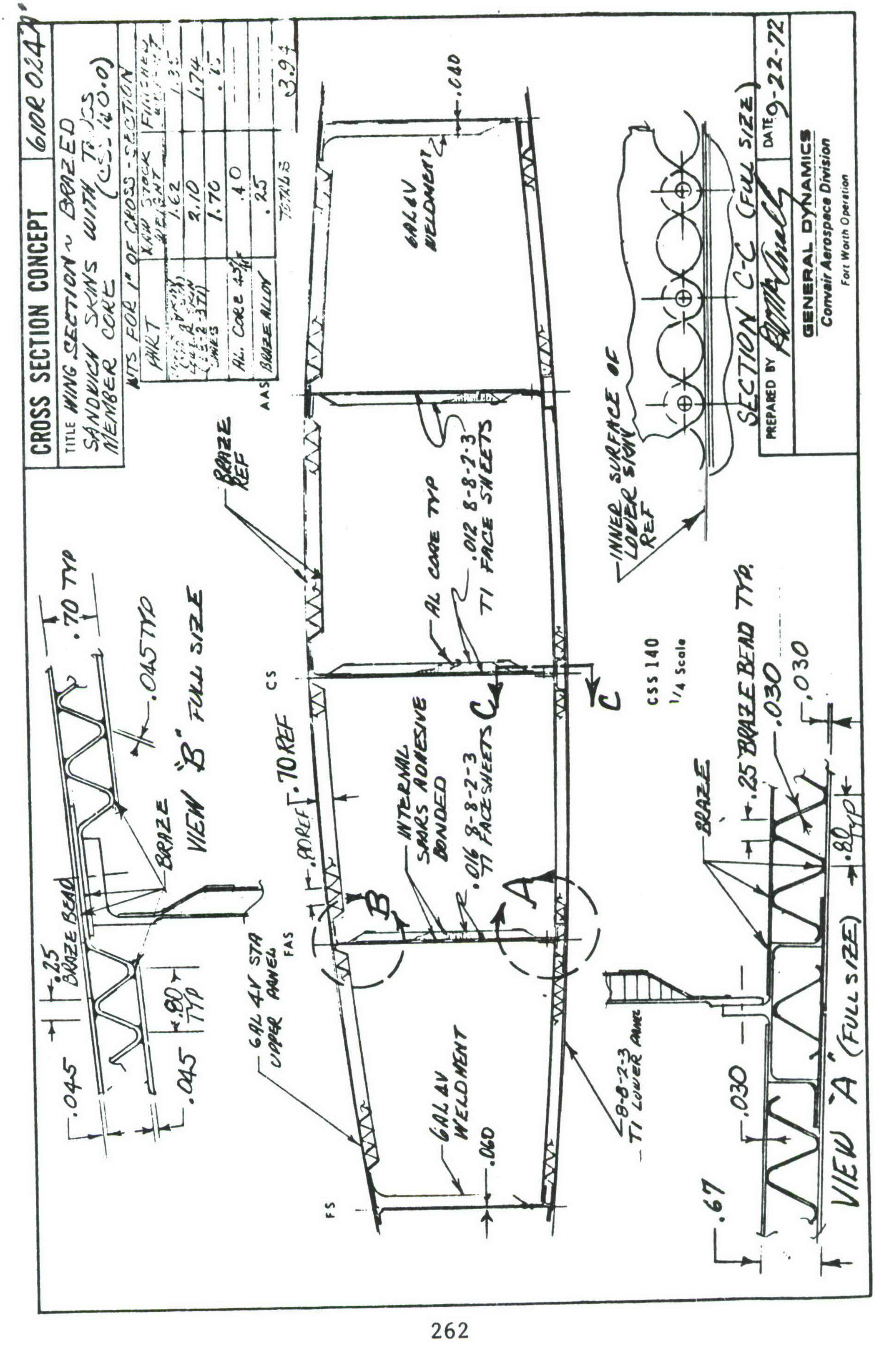
Dimension	-1 Upper Surface	-1 Lower Surface	-2 Upper Surface	-2 Lower Surface
b_s			1.05	1.00
h			.67	.50
t_s			.071	.071
t_h			.160	.120



DETAIL B

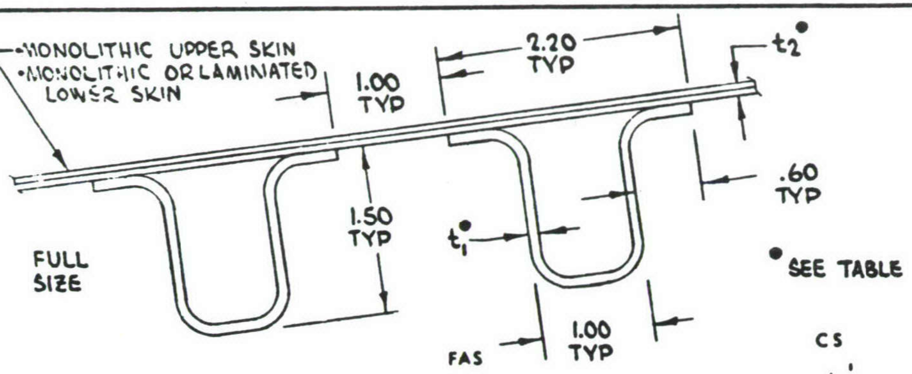
PREPARED BY [signature] DATE 9/21/72

GENERAL DYNAMICS
Convair Aerospace Division
Fort Worth Operation


CROSS SECTION CONCEPT
TITLE WING SECTION ~ BRAZED SANDWICH SKINS WITH TRUSS MEMBER CORE
GENERAL DYNAMICS
Convair Aerospace Division
Fort Worth Operation
PREPARED BY
DATE 9-22-72
SECTION C-C (FULL SIZE)
INNER SURFACE OF LOWER SKIN REF
6AL 4V WELDMENT
.060
.080
BRAZE REF
AL CORE TYP
.012 8-8-2-3 TI FACE SHEETS
.016 8-8-2-3 TI FACE SHEETS
INTERNAL SPARS ADHESIVE BONDED
.70 REF
.80 REF
6AL 4V STA UPPER PANEL
8-8-2-3 TI LOWER PANEL
FS
FAS
CS
AAS
CSS 140
1/4 Scale
VIEW "B" FULL SIZE
VIEW "A" (FULL SIZE)
.25 BRAZE BEAD
.25 BRAZE BEAD TYP.
BRAZE
.70 TYP
.045 TYP
.045
.80 TYP
.030
.67

CROSS SECTION CONCEPT | 610R-025

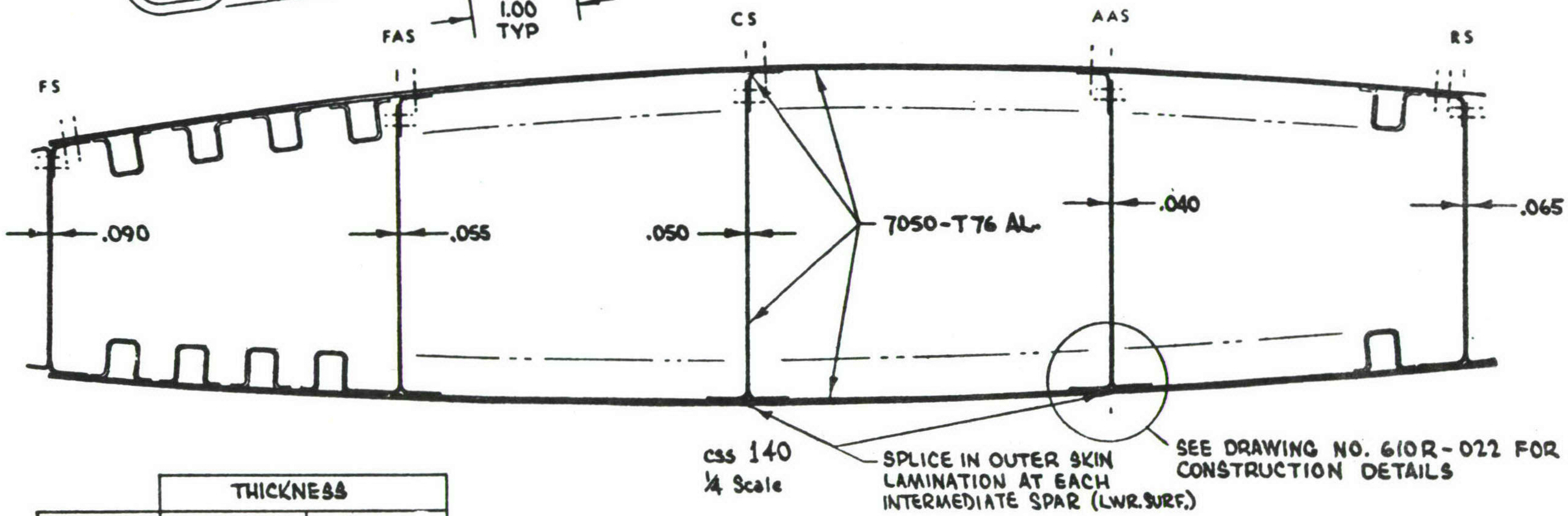
TITLE WING SECTION - ADHESIVE BONDED HAT STIFFENERS
7050 ALUMINUM



• SEE TABLE

NOTE: • AS AN ALTERNATE, CONSIDER THIS DESIGN WITH:
- PLATE SKINS INSTEAD OF LAMINATED (LWR. SURF)
- RIVETED OR RIVET-BONDED SPARS AND UPR HATS

• THIS CONFIGURATION MAY BE USED OUTBOARD OF CSS 140; REFER TO DWG. NO. 610R-119



LOCATION	THICKNESS STIFFENER t_1	THICKNESS SKIN t_2
UPPER SURFACE	.090	.125
LOWER SURFACE	.080	.100*

* MAY BE LAMINATED OR PLATE

WEIGHTS OF 1 INCH OF CROSS SECTION

PART	Stock Wts.	Finished Wts.
Upper Skin	2.40	2.00
Lower Skin	2.40	2.00
Spars	2.00	1.66
	TOTAL	5.66

PREPARED BY D. E. B[illegible] DATE 9-25-72

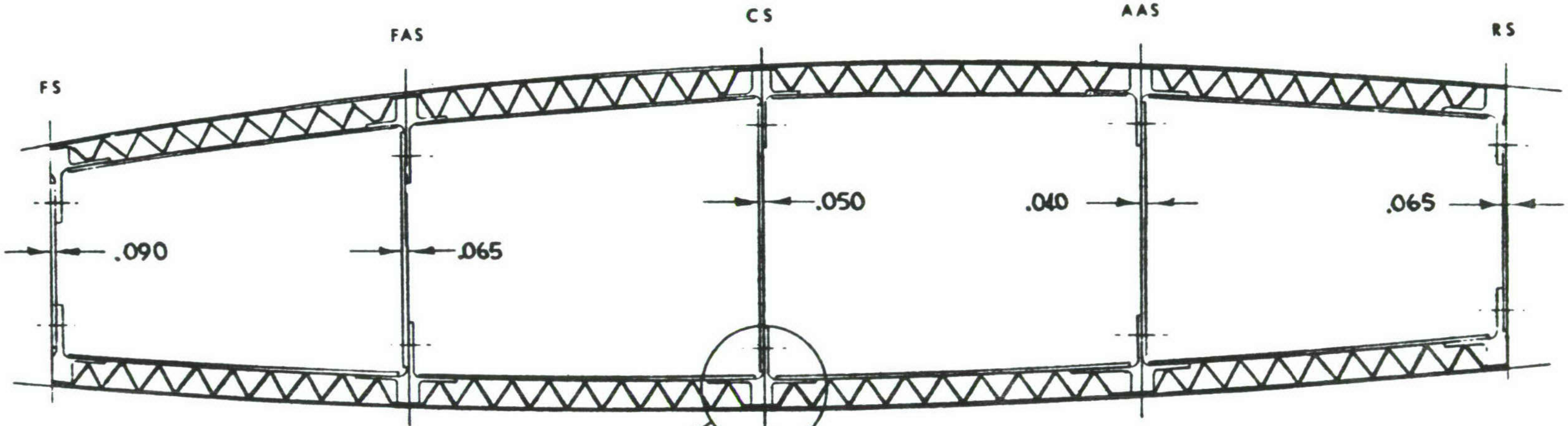
GENERAL DYNAMICS
Convair Aerospace Division
Fort Worth Operation

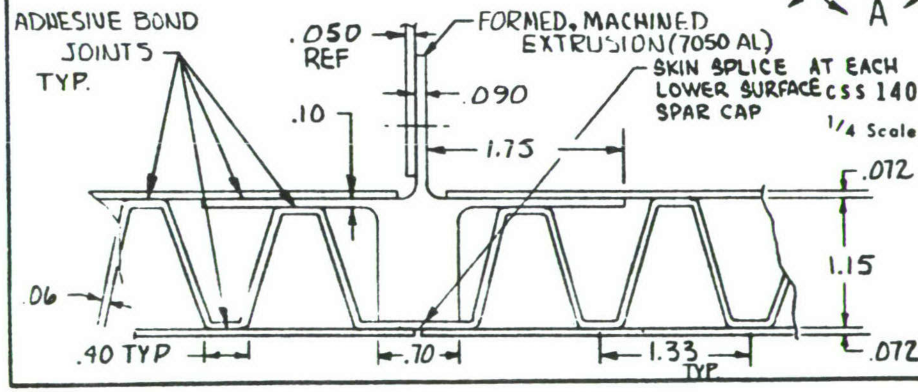
CROSS SECTION CONCEPT	610R-026
TITLE WING SECTION ~ MODIFIED TRIANGLE CORE, ADHESIVE BONDED ALUMINUM	

A

PART	STOCK WEIGHTS	FINISHED WEIGHTS
UPPER SKIN	2.52	2.10
LWR SKIN	2.33	1.94
SPARS	2.49	1.66
TOTAL		5.70

MATL:
SKINS AND CORE - 7050-T76 AL SHEET
SPARS - 7050 ALUMINUM.





NOTE: THIS CONFIGURATION MAY BE USED OUTBOARD OF CSS 140; REFER TO DWG. NO. 610R-118

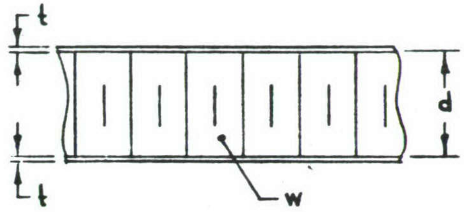
PREPARED BY J.D. Bixler | DATE 9/29/72

GENERAL DYNAMICS
Convair Aerospace Division
Fort Worth Operation

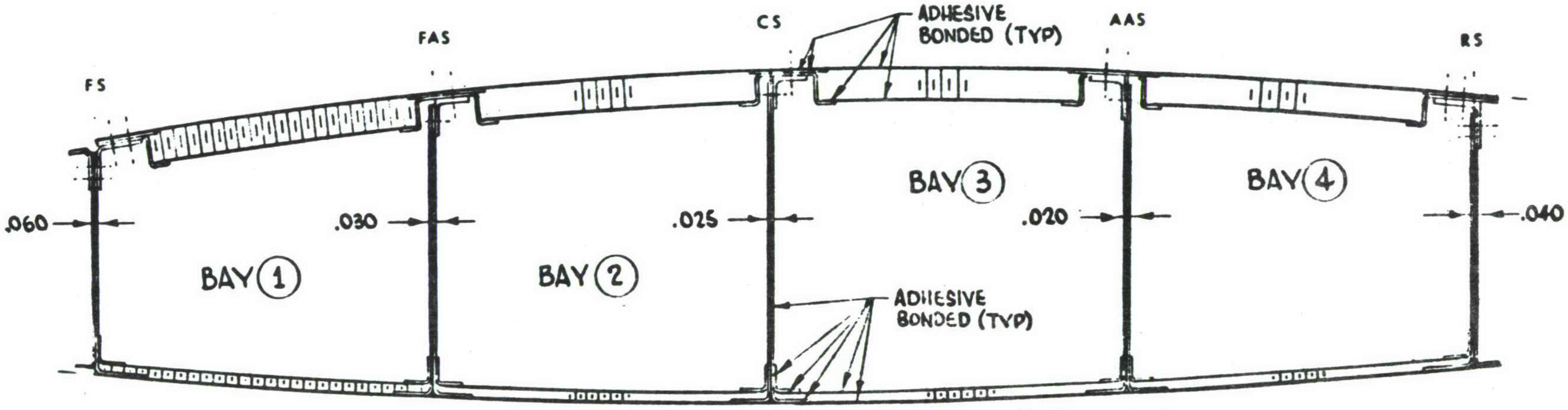
CROSS SECTION CONCEPT 610R-027

TITLE WING SECTION – HONEYCOMB SANDWICH PANEL; SPARS INTEGRAL WITH LOWER SURFACE PANEL; ADHESIVE BONDED

HONEYCOMB SANDWICH PANEL DIMENSIONS



	Upper Surface		Lower Surface	
	Bays (1) - (3)	Bay (4)	Bays (1) - (3)	Bay (4)
d, Core Depth, in.	1.25	1.25	.50	.50
t, Face Thickness, in.	.071	.037	.063	.025
w, Core Wt., lb/ft³	4.5	4.5	4.5	4.5



MATERIALS

UPPER SURFACE	Core	5056 Aluminum
	Faces	6Al-4V STA Titanium
	Spar Caps	6Al-4V STA Titanium
LOWER SURFACE	Core	5056 Aluminum
	Faces	8-8-2-3 Titanium
	Spar Caps	8-8-2-3 Titanium

WEIGHT OF 1 INCH OF CROSS SECTION

PART	STOCK WT.	FINISHED WT.
UPPER PANEL	1.80	1.49
LOWER PANEL	1.50	1.26
SPARS	3.00	1.50
	TOTAL	4.25

CSS 140
1/4 Scale

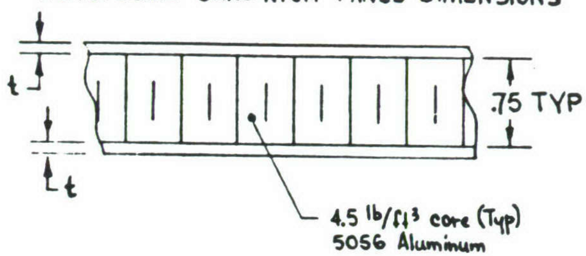
PREPARED BY [signature] DATE 10-3-72

GENERAL DYNAMICS
Convair Aerospace Division
Fort Worth Operation

CROSS SECTION CONCEPT — 610R-028

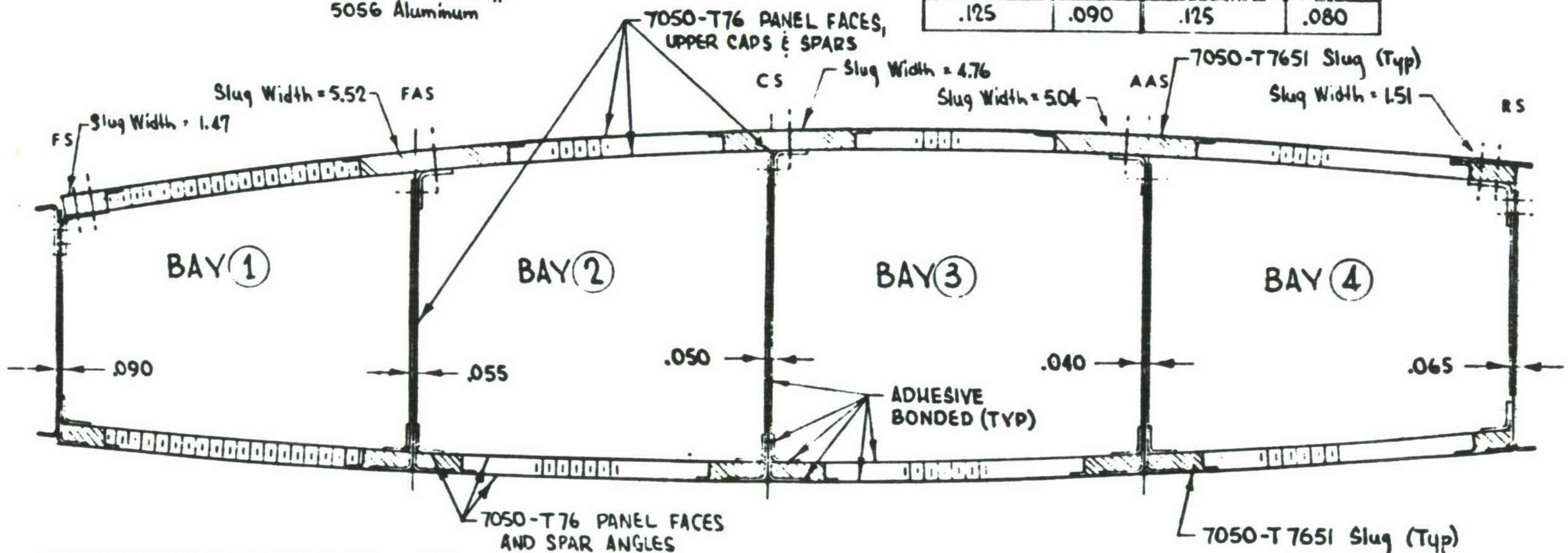
TITLE WING SECTION – ALUMINUM HONEYCOMB PANEL, UPPER & LOWER; INTEGRAL LOWER SPAR CAPS; ADHESIVE BONDED

HONEYCOMB SANDWICH PANEL DIMENSIONS



FACE THICKNESS, t (INCHES)

Upper Surface		Lower Surface	
Bays (1) - (3)	Bay 4	Bays (1) - (3)	Bay (4)
.125	.090	.125	.080



CSS 140

1/4 Scale

WEIGHT OF 1 INCH OF CROSS SECTION

	PART	STOCK WT.	FINISHED WT.
Upper Surface	Slugs & Spar Caps	1.68	1.40
	Skin Panel	1.69	1.41
	Fasteners	–	.07
Lower Surface	Slugs & Spar Caps	1.28	1.07
	Skin Panel	1.66	1.39
	Spar Webs	.36	.30
	TOTAL		5.64

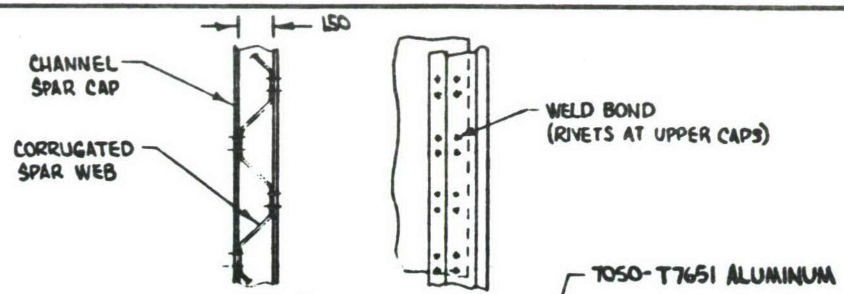
PREPARED BY [signature] DATE 10·10·72

GENERAL DYNAMICS
Convair Aerospace Division
Fort Worth Operation

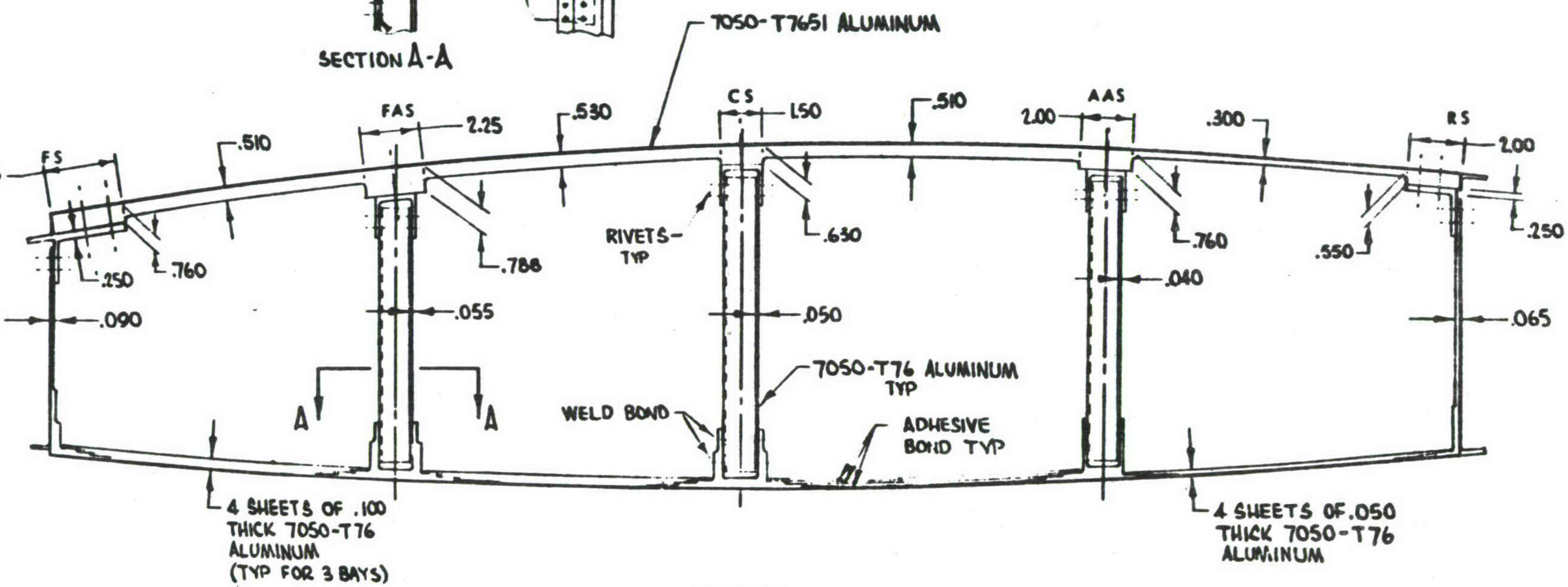
CROSS SECTION CONCEPT	610R-029

TITLE WING SECTION-LAMINATED LOWER SKINS WITH STEPPED SPAR CAPS; PLATE UPPER SKIN; CORRUGATED SPAR WEBS

NOTE: FRONT AND REAR SPARS, AND UPPER AND LOWER SPAR CAPS ARE 7050-T73651 ALUMINUM



SECTION A-A



CSS 140

1/4 Scale

WEIGHTS OF 1 INCH OF CROSS SECTION

PART	Stock Weights	Finished Weights
Upper Skin	4.28	2.73
Lower Skins & Stepped Caps	2.76	2.30
Spars		
Upper Caps	.43	.36
Webs	.54	.45
TOTAL		5.84

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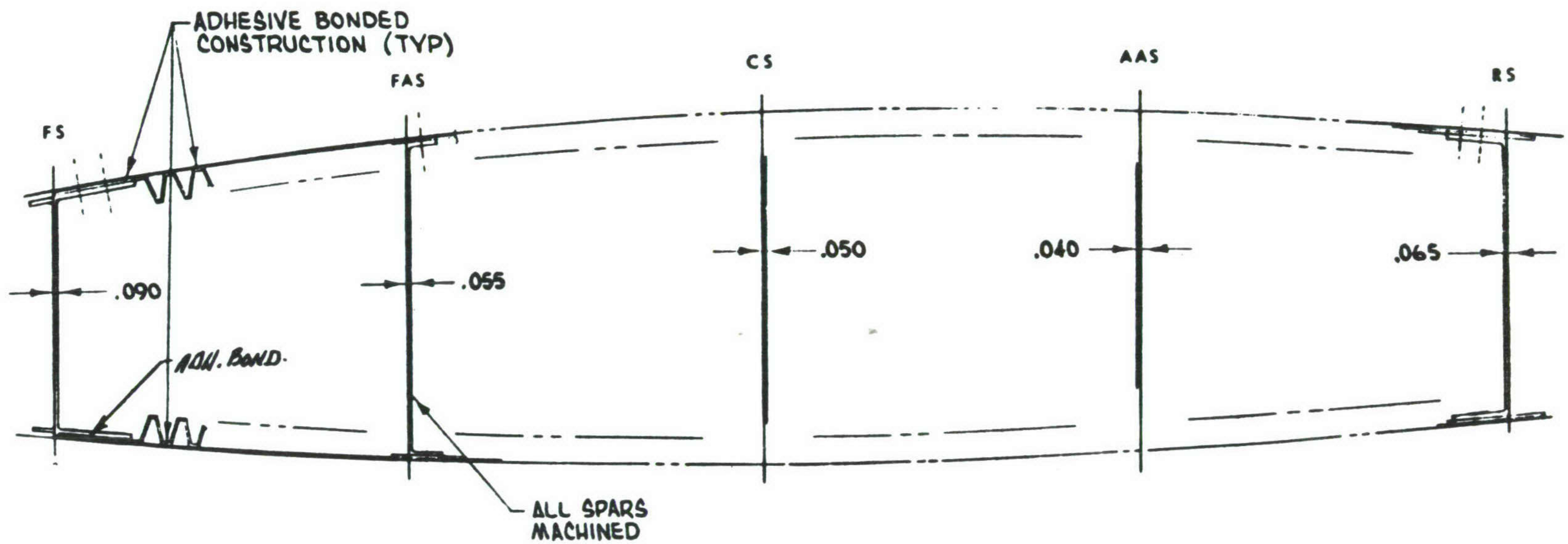
GENERAL DYNAMICS
Convair Aerospace Division
Fort Worth Operation

CROSS SECTION CONCEPT 610R-030

TITLE WING SECTION- ADHESIVE BONDED, CORRUGATED STIFFENER INNER SKIN CSS 140

NOTE: • REFER TO DWG. NO. 610R-116 (AT CSS 340) FOR DETAILS OF CONSTRUCTION
• THIS CONFIGURATION MAY BE USED OUTBOARD OF CSS 140; REFER TO DWG. NO. 610R-116

ALL MATERIAL IS 7050 ALUMINUM



CSS 140
1/4 Scale

WEIGHTS FOR 1 INCH OF CROSS SECTION

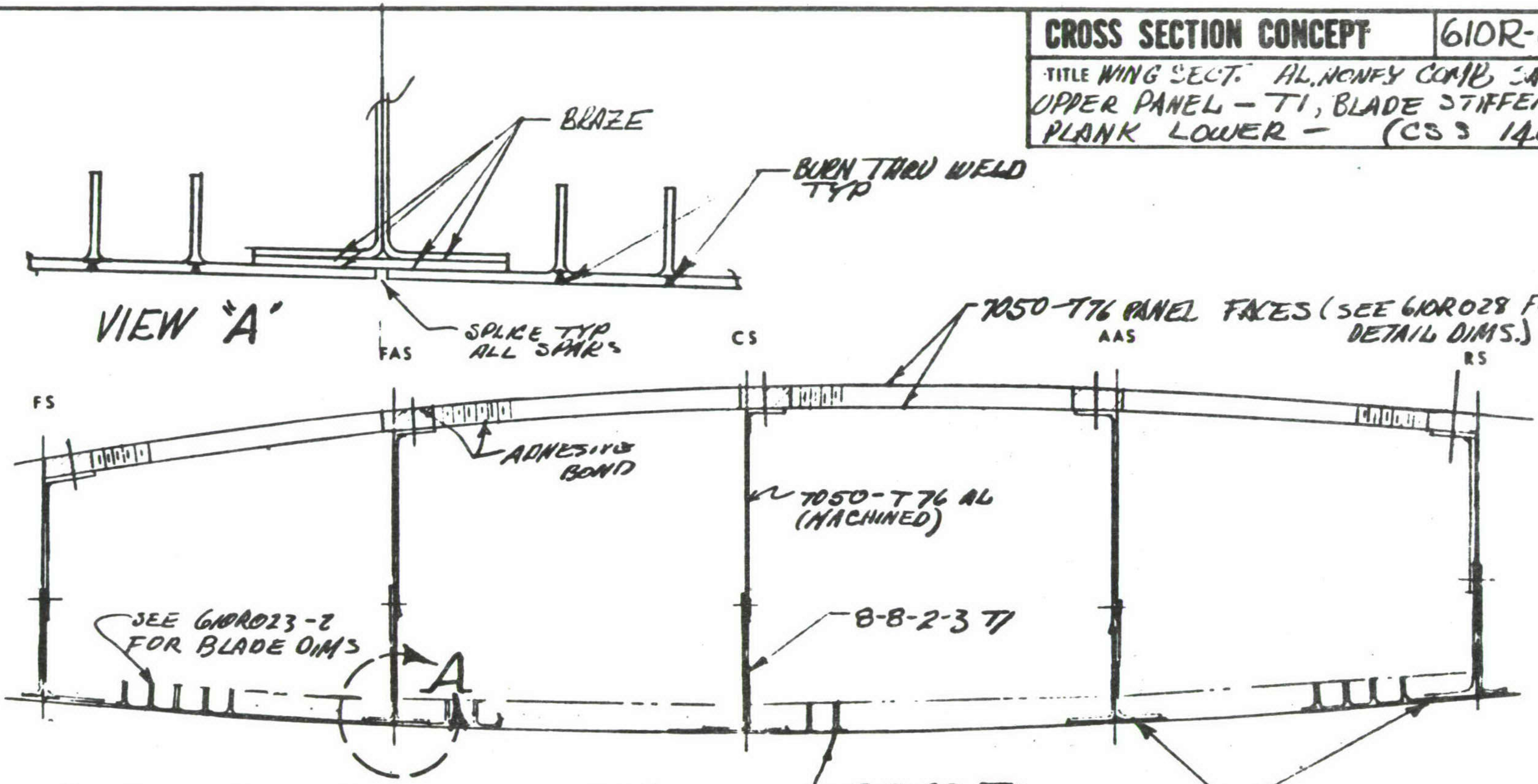
PART	STOCK WT.	FINISHED WT.
Upper Panel	2.64	2.20
Lower Panel	2.33	1.94
Spars	14.30	1.70
Adhesive	.05	.02
	TOTAL	5.86

PREPARED BY J. E. Bloom DATE 10-25-72

GENERAL DYNAMICS
Convair Aerospace Division
Fort Worth Operation

CROSS SECTION CONCEPT 610R-031

TITLE WING SECT. AL. HONEY COMB SAND. UPPER PANEL – TI, BLADE STIFFENED PLANK LOWER – (CSS 140.0)



WEIGHT OF 1 INCH OF CROSS-SECTION

PART	STOCK WT.	FINISHED WT.
UPPER PANEL ([illegible])	3.30	2.70
LOWER PANEL	1.60	1.39
SPARS (UPPER AL)	6.00	.25
SPARS (LOWER TI)	.90	.18
TOTAL		4.82

CSS 140

1/4 Scale

PREPARED BY [signature] DATE 10/31/72

GENERAL DYNAMICS

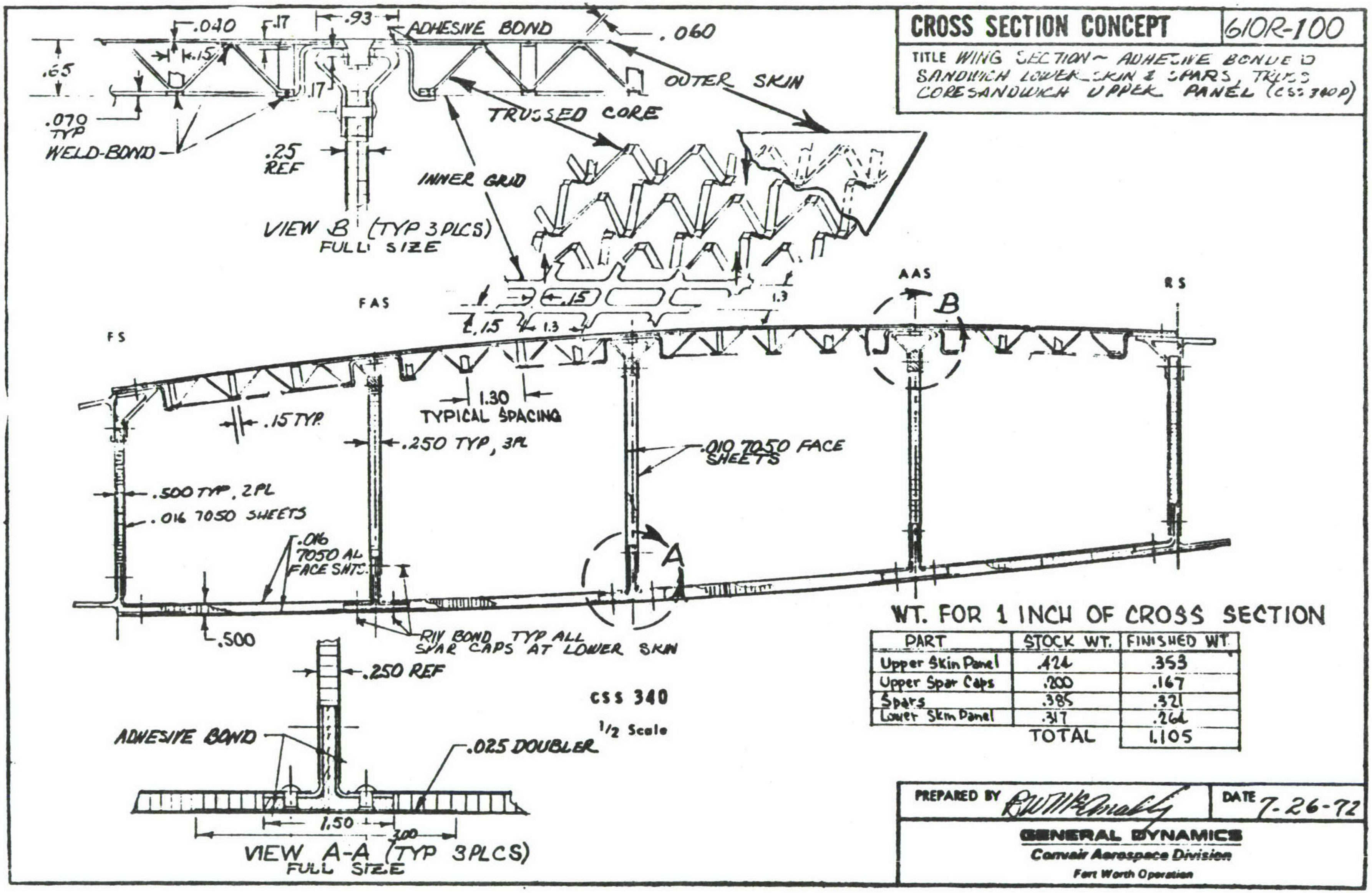
Convair Aerospace Division

Fort Worth Operation

CROSS-SECTION CONCEPTS

FOR CENTER SPAR STATION 340.0

DRAWING NO. 610R-100 THROUGH 610R-120



CROSS SECTION CONCEPT 610R-100

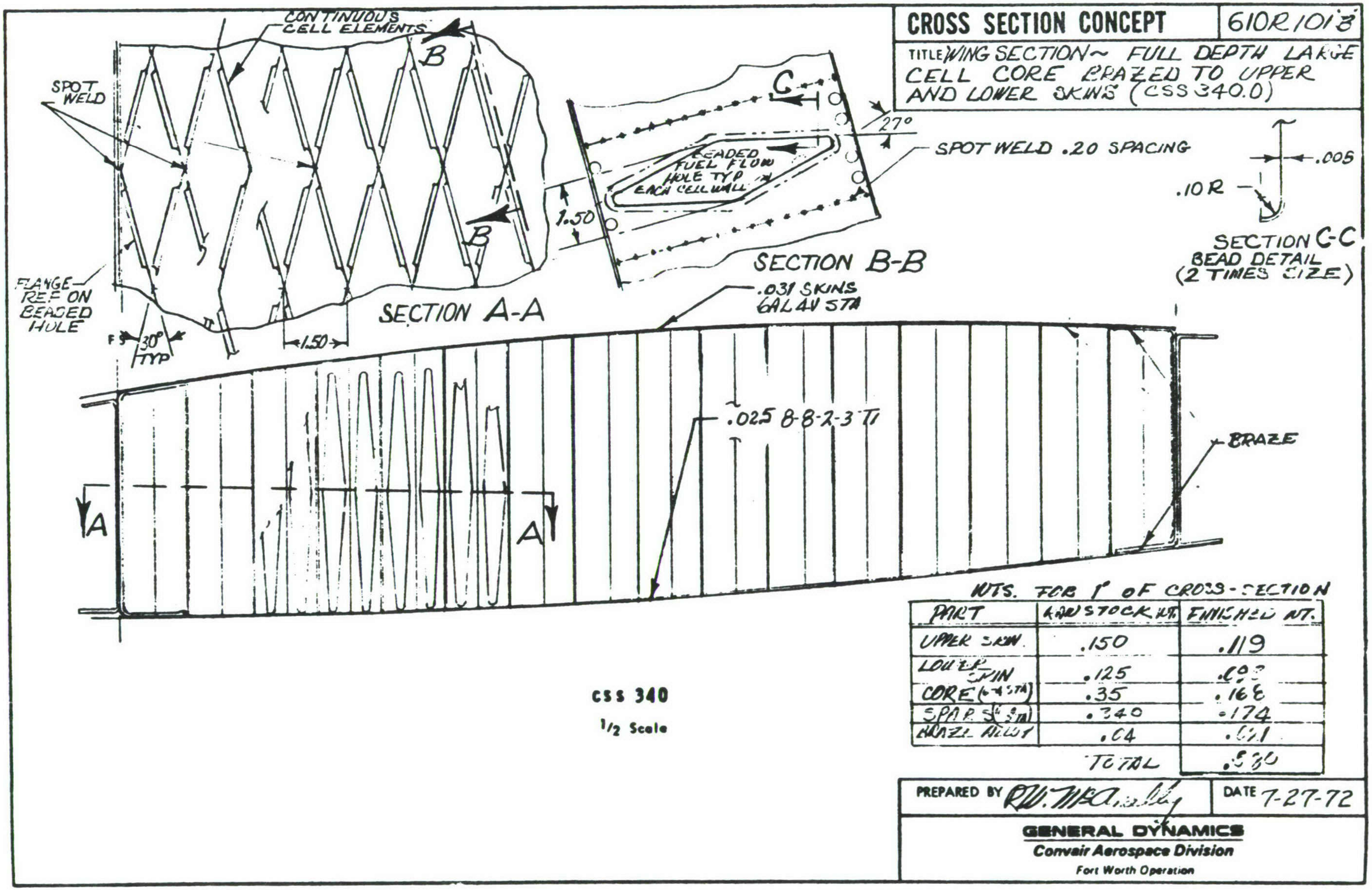
TITLE WING SECTION ~ ADHESIVE BONDED SANDWICH LOWER SKIN & SPARS, TRUSS CORE SANDWICH UPPER PANEL (CSS 340P)

WT. FOR 1 INCH OF CROSS SECTION

PART	STOCK WT.	FINISHED WT.
Upper Skin Panel	.424	.353
Upper Spar Caps	.200	.167
Spars	.385	.321
Lower Skin Panel	.317	.264
	TOTAL	1.105

PREPARED BY RWMcAnally DATE 7-26-72

GENERAL DYNAMICS
Convair Aerospace Division
Fort Worth Operation



WTS. FOR 1" OF CROSS-SECTION

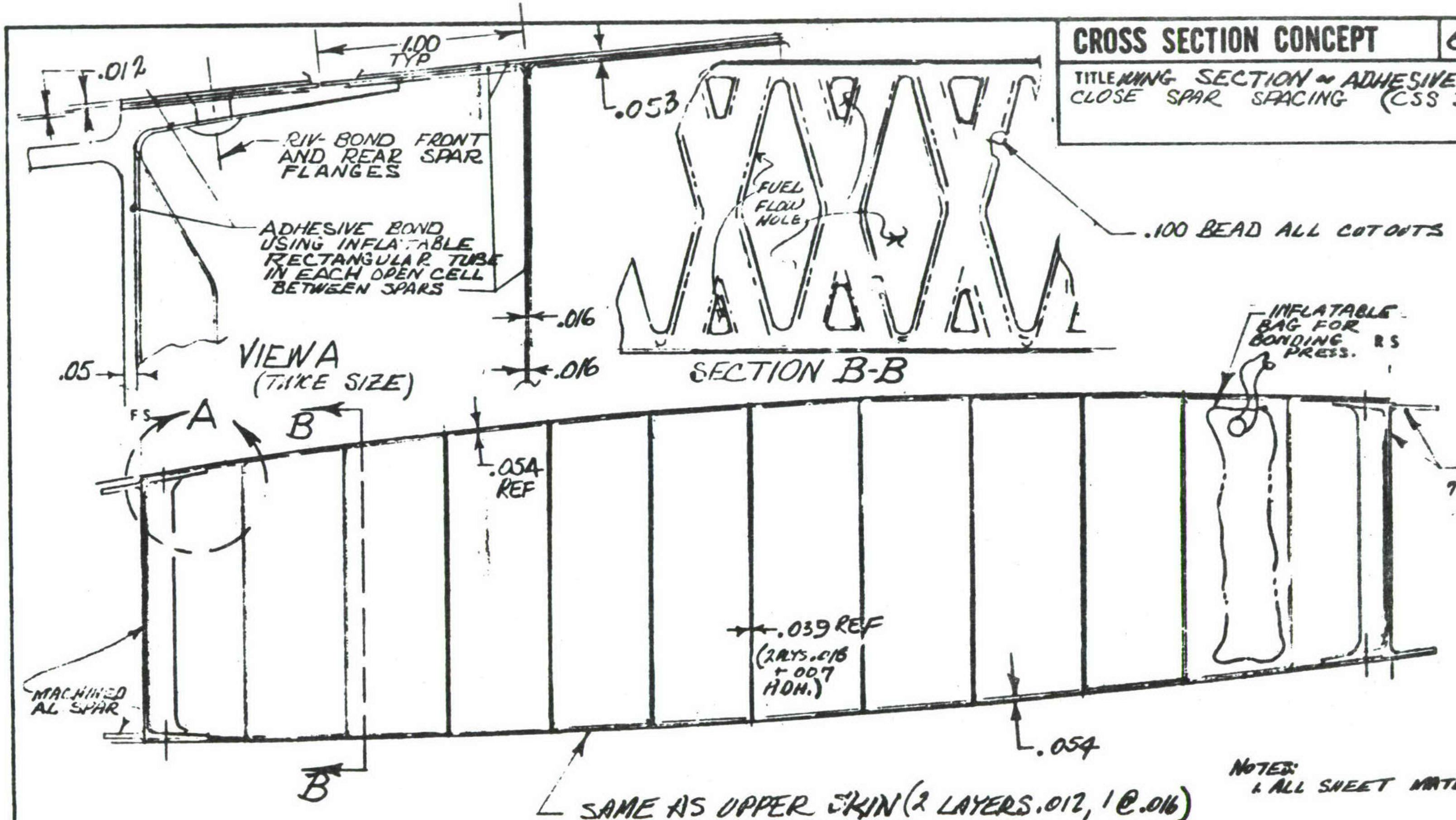
PART	RAW STOCK WT.	FINISHED WT.
UPPER SKIN	.150	.119
LOWER SKIN	.125	.098
CORE (6-4 STA)	.35	.168
SPARS (6-4 STA)	.340	.174
BRAZE ALLOY	.04	.021
	TOTAL	.580

CSS 340

1/2 Scale

CROSS SECTION CONCEPT 610R1028

TITLE WING SECTION ~ ADHESIVE BONDED CLOSE SPAR SPACING (CSS 340.0)



NOTES:
1. ALL SHEET MATL 7050-AL

CSS 340

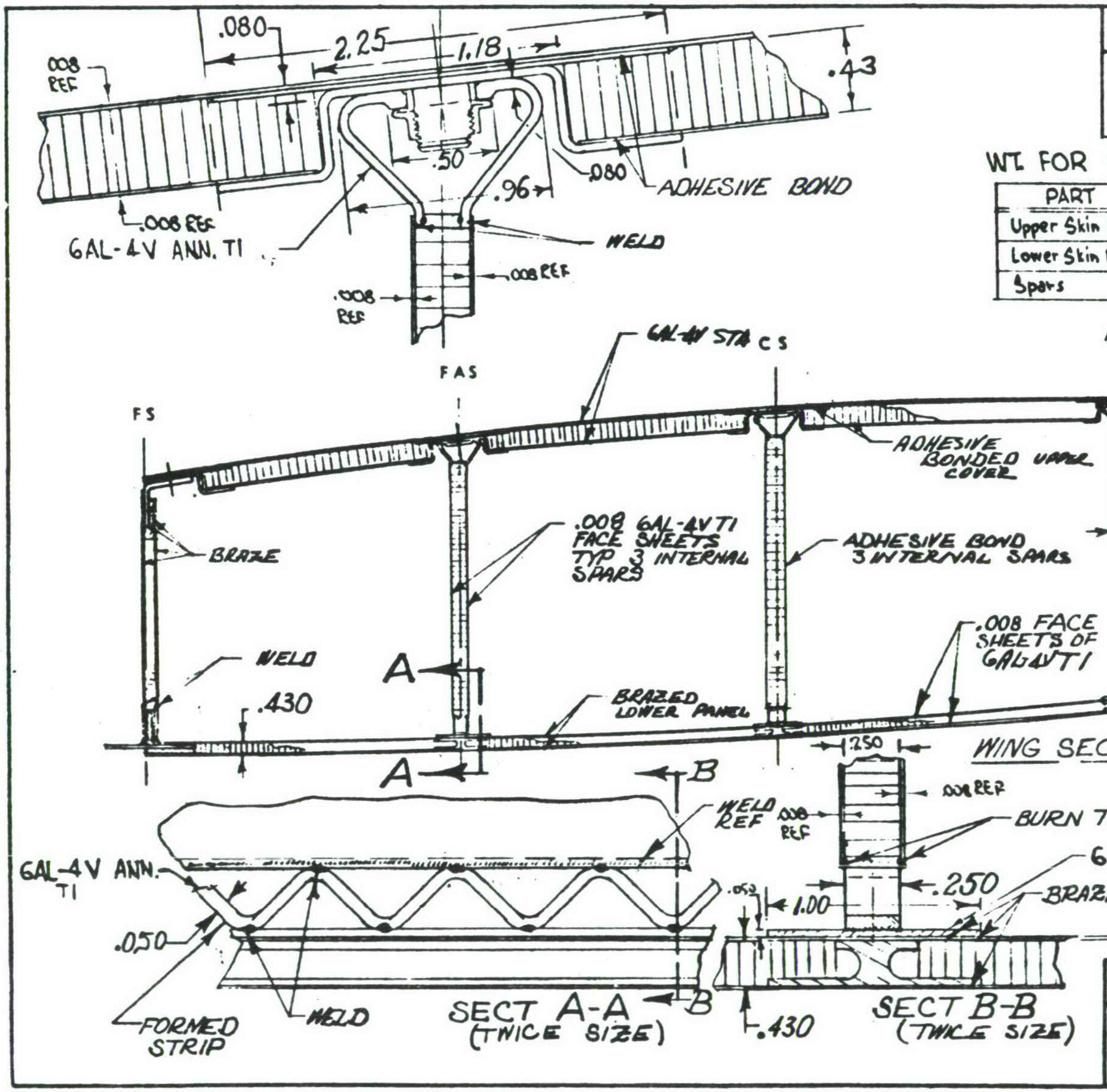
1/2 Scale

PART	STK. WT.	FIN. WEIGHT
UPPER SKIN	.180	.118
LOWER SKIN	.180	.118
VERTICAL WEBS	.40	.228
FR. & REAR SPAR	3.6	.160
TOTAL		.624

PREPARED BY [signature] DATE 7-27-7[illegible]

Convair [illegible]

Fort Worth [illegible]



CROSS SECTION CONCEPT

610R-103A

TITLE WING SECTION W BRAZED TI SANDWICH LOWER PANEL, BONDED TI SANDWICH UPPER PANEL (CSS 340.0)

WT. FOR 1 INCH OF CROSS SECTION

PART	STOCK WT.	FINISHED WT.
Upper Skin Panel	.302	.252
Lower Skin Panel	.409	.341
Spars	.559	.466
	TOTAL	1.059

5056 ALUM CORE MATL.

LOCATION	CORE DENS. LB/FT³
All Skin Panels	8.1
Front & Rear Spars	8.1
Intermediate Spars	3.1

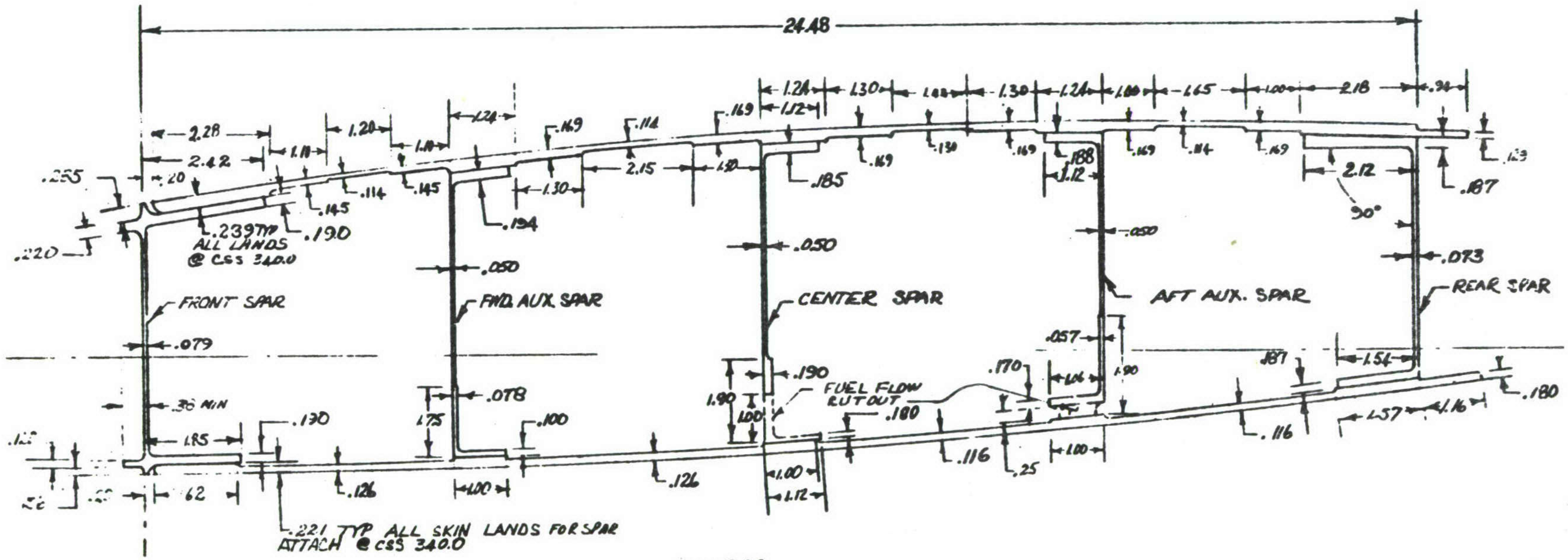
PREPARED BY R.W. McAnally DATE 8-2-72

GENERAL DYNAMICS
Convair Aerospace Division
Fort Worth Operation

CROSS SECTION CONCEPT 610R-104

TITLE F111F WING BOX ~ SECTION CUT AT CENTER SPAR STA 340.0

PART	RAW STOCK	FINISHED WT.
UPPER SKIN	1.40	.432
LOWER SKIN	1.40	.373
SPARS	7.6	.490
	TOTALS	1.295

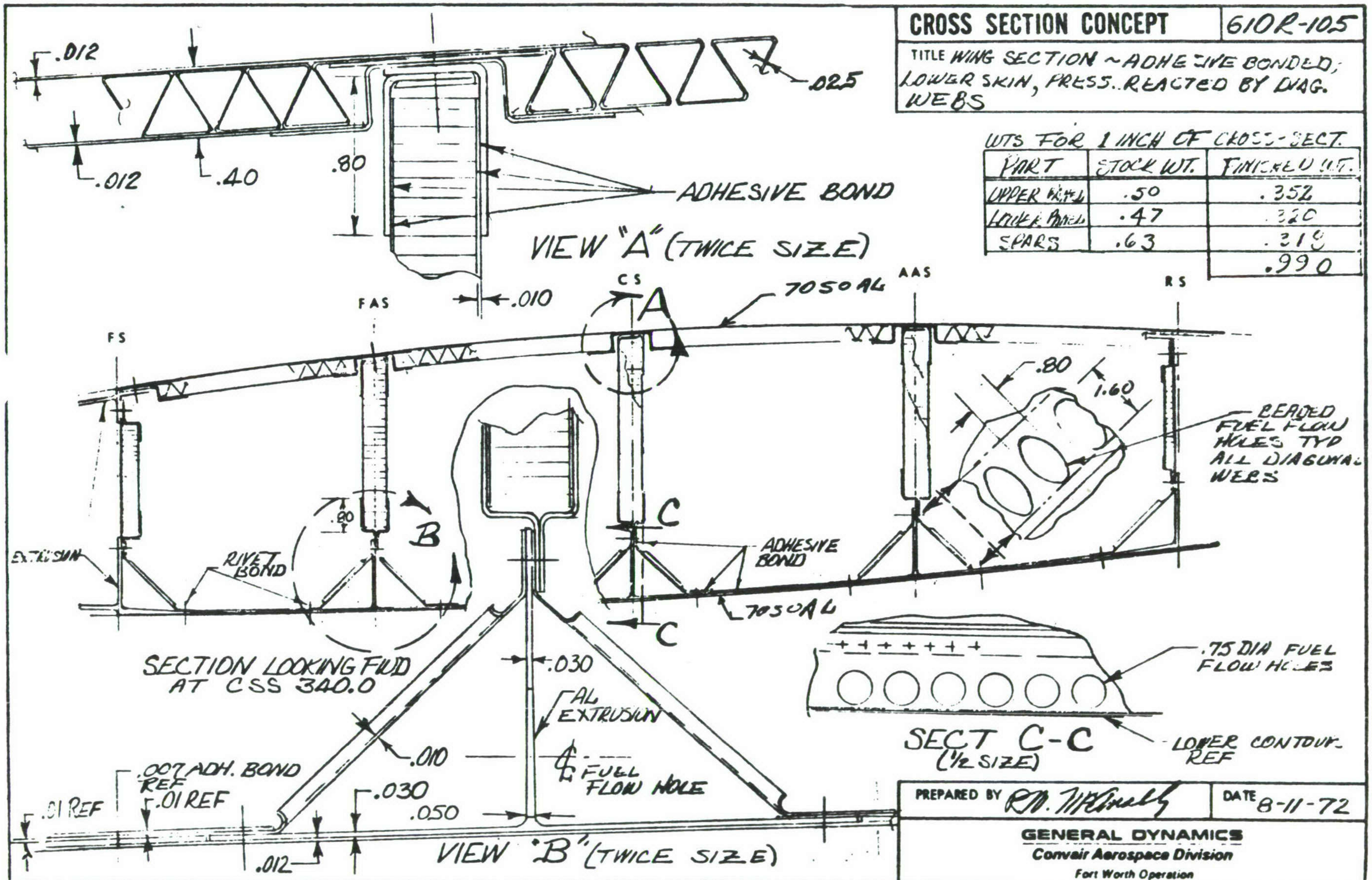


CSS 340

1/2 Scale

PREPARED BY [signature] DATE 6-23-72

GENERAL DYNAMICS
Convair Aerospace Division
Fort Worth Operation



CROSS SECTION CONCEPT 610R-105

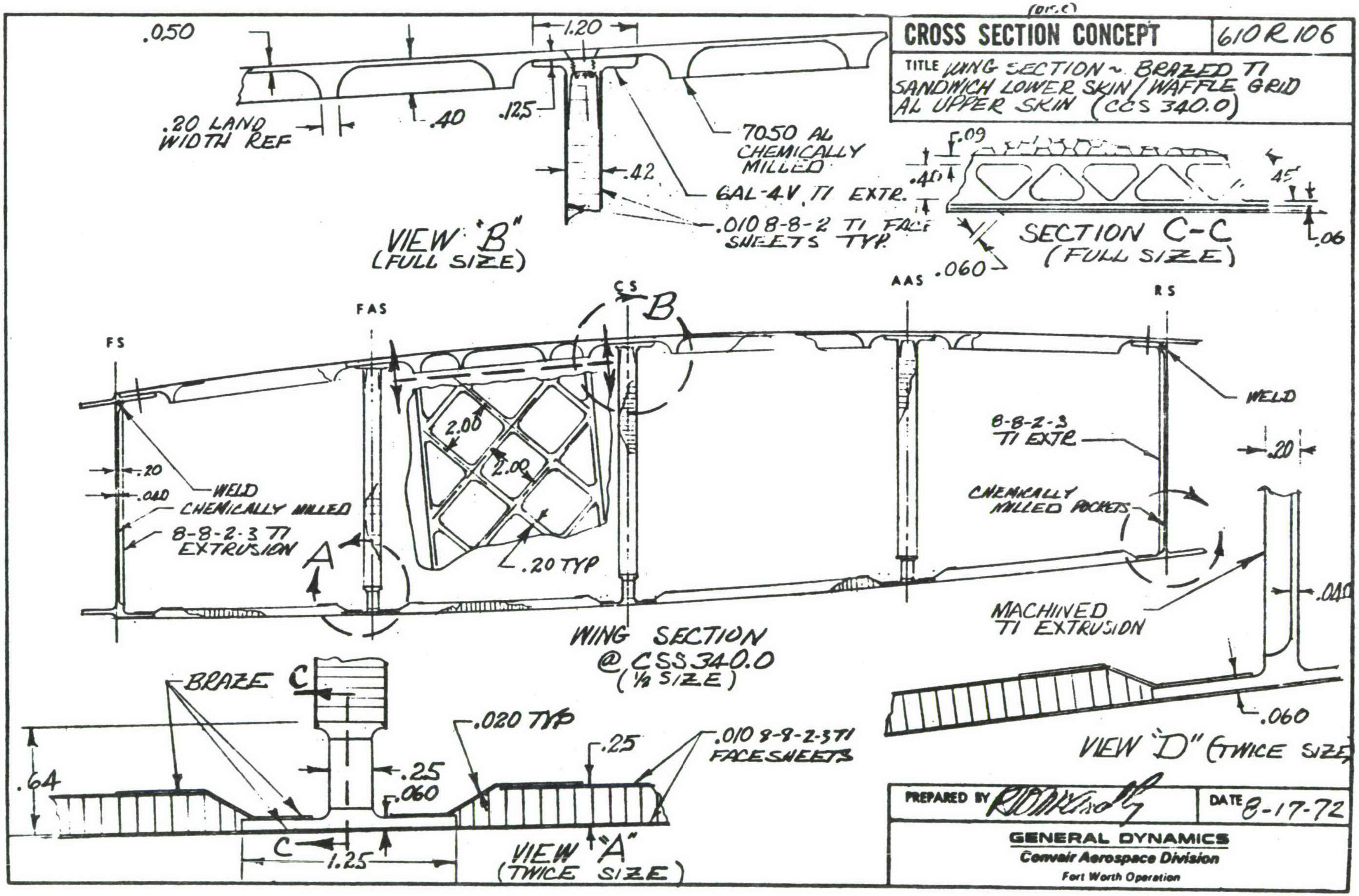
TITLE WING SECTION ~ ADHESIVE BONDED; LOWER SKIN, PRESS. REACTED BY DIAG. WEBS

WTS FOR 1 INCH OF CROSS-SECT.

PART	STOCK WT.	FINISHED WT.
UPPER PANEL	.50	.352
LOWER PANEL	.47	.320
SPARS	.63	.318
		.990

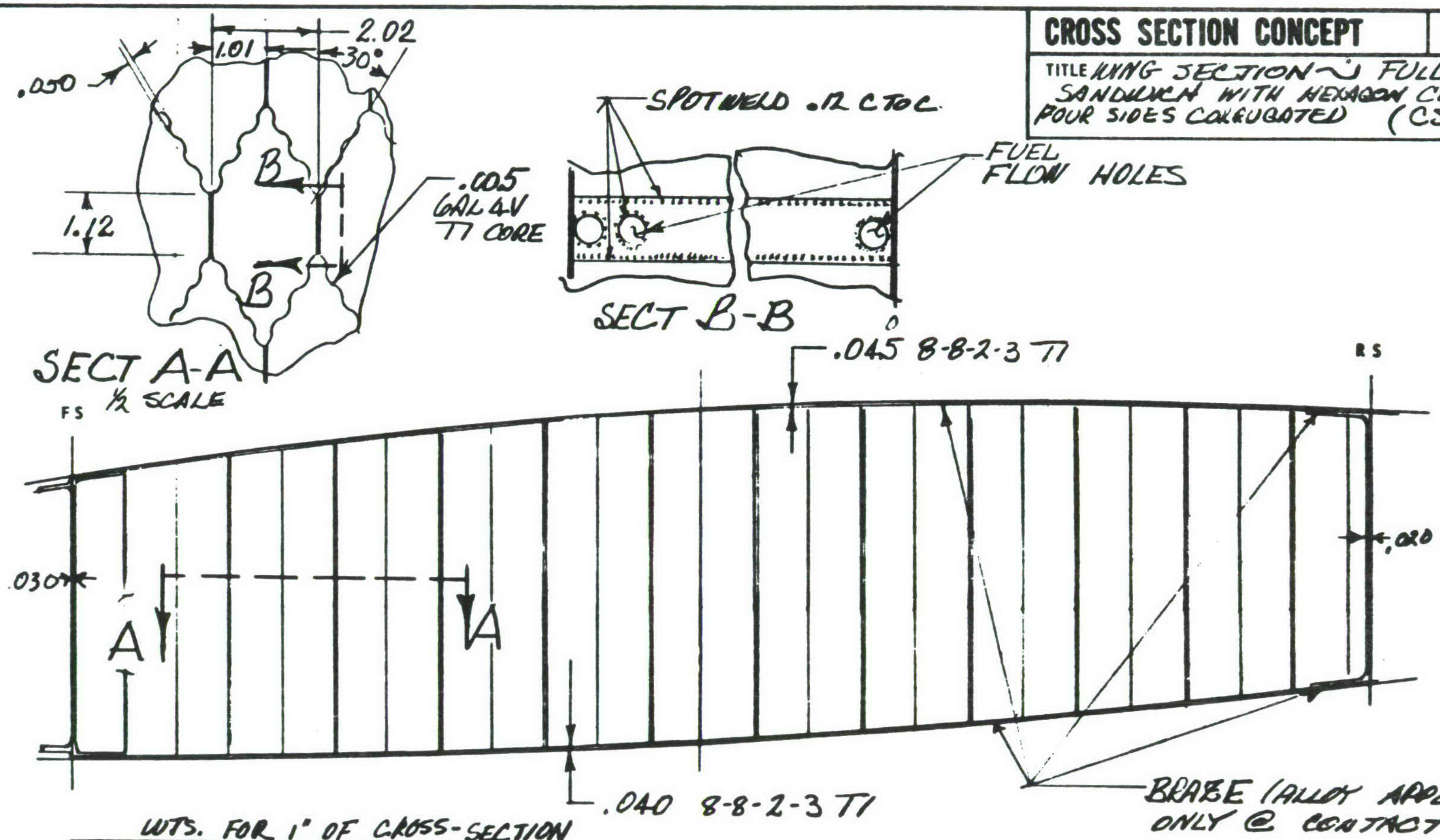
PREPARED BY R.D. McKinely DATE 8-11-72

GENERAL DYNAMICS
Convair Aerospace Division
Fort Worth Operation


CROSS SECTION CONCEPT
610R106
TITLE WING SECTION ~ BRAZED TI SANDWICH LOWER SKIN / WAFFLE GRID AL UPPER SKIN (CCS 340.0)
.050
1.20
.20 LAND WIDTH REF
.40
.125
.42
7050 AL CHEMICALLY MILLED
6AL-4V TI EXTR.
.010 8-8-2 TI FACE SHEETS TYP
VIEW "B" (FULL SIZE)
.09
.40
45°
.06
.060
SECTION C-C (FULL SIZE)
FS
FAS
CS
AAS
RS
B
A
2.00
.20 TYP
.20
.040
WELD
CHEMICALLY MILLED
8-8-2-3 TI EXTRUSION
8-8-2-3 TI EXTR
CHEMICALLY MILLED POCKETS
MACHINED TI EXTRUSION
WING SECTION @ CSS 340.0 (1/2 SIZE)
.060
VIEW "D" (TWICE SIZE)
BRAZE
C
.64
.25
.060
1.25
.020 TYP
.010 8-8-2-3 TI FACESHEETS
VIEW "A" (TWICE SIZE)
PREPARED BY
DATE 8-17-72
GENERAL DYNAMICS
Convair Aerospace Division
Fort Worth Operation

CROSS SECTION CONCEPT — 610R108

TITLE WING SECTION ~ FULL DEPTH SANDWICH WITH HEXAGON CELL CORE, FOUR SIDES CORRUGATED (CSS 340.0)

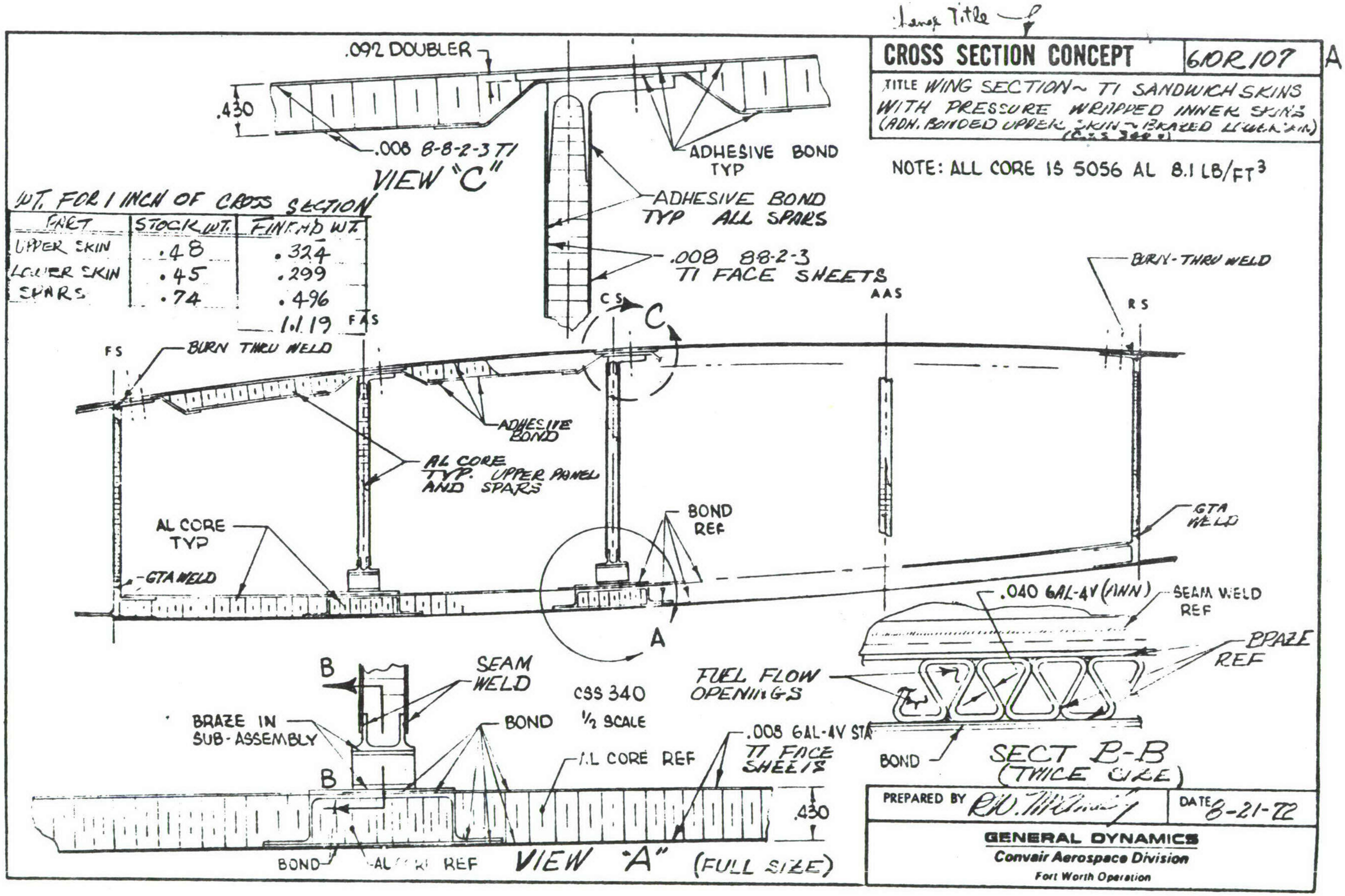


WTS. FOR 1" OF CROSS-SECTION

PART	RAW STOCK WT.	FINISHED WT.
UPPER SKIN	.24	.200
LOWER SKIN	.21	.179
CORE	.27	.137
SPARS	.340 (6-3/4 3/4 A)	.174
BRAZE ALLOY	.030	.016
		.706

PREPARED BY [signature] DATE 2-18-72

GENERAL DYNAMICS
Convair Aerospace Division
Fort Worth Operation

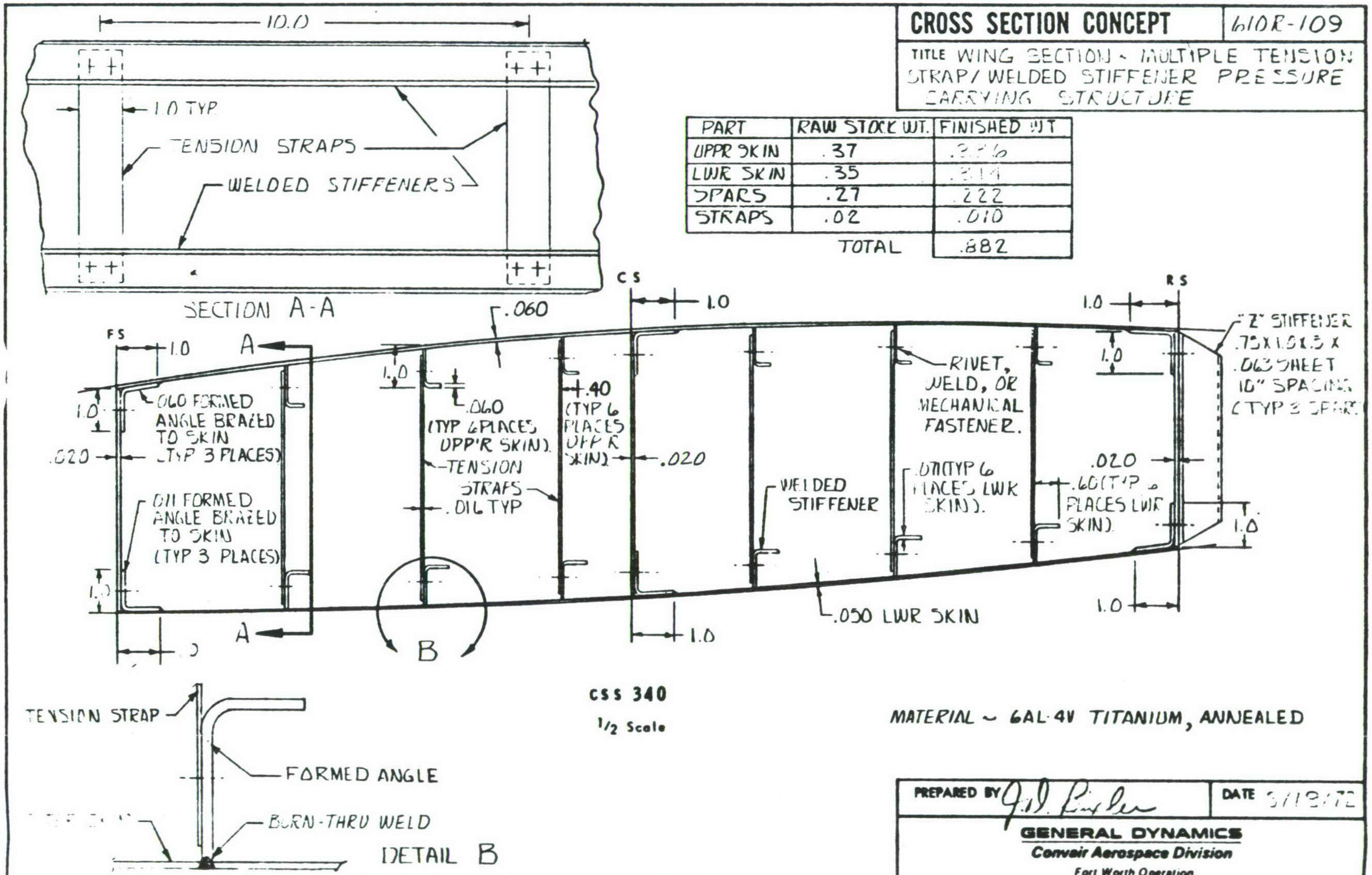


Change Title
CROSS SECTION CONCEPT
61OR 107
A
TITLE WING SECTION ~ TI SANDWICH SKINS WITH PRESSURE WRAPPED INNER SKINS (ADH. BONDED UPPER SKIN ~ BRAZED LOWER SKIN)
NOTE: ALL CORE IS 5056 AL 8.1 LB/FT³
.092 DOUBLER
.430
.008 8-8-2-3 TI
VIEW "C"
ADHESIVE BOND TYP
ADHESIVE BOND TYP ALL SPARS
.008 88-2-3 TI FACE SHEETS
WT. FOR 1 INCH OF CROSS SECTION
PART
STOCK WT.
FINISHED WT.
UPPER SKIN
LOWER SKIN
SPARS
.48
.45
.74
.324
.299
.496
1.119
FS
FAS
CS
C
AAS
RS
BURN THRU WELD
BURN-THRU WELD
ADHESIVE BOND
AL CORE TYP. UPPER PANEL AND SPARS
AL CORE TYP
GTA WELD
BOND REF
A
.040 6AL-4V (ANN)
SEAM WELD REF
BRAZE REF
FUEL FLOW OPENINGS
BOND
SECT B-B (TWICE SIZE)
B
SEAM WELD
CSS 340
1/2 SCALE
BRAZE IN SUB-ASSEMBLY
BOND
AL CORE REF
.008 6AL-4V STA TI FACE SHEETS
.430
VIEW "A" (FULL SIZE)
PREPARED BY
DATE 8-21-72
GENERAL DYNAMICS
Convair Aerospace Division
Fort Worth Operation

CROSS SECTION CONCEPT — 610R-109

TITLE WING SECTION ~ MULTIPLE TENSION STRAP/WELDED STIFFENER PRESSURE CARRYING STRUCTURE

PART	RAW STOCK WT.	FINISHED WT
UPPR SKIN	.37	.336
LWR SKIN	.35	.314
SPARS	.27	.222
STRAPS	.02	.010
	TOTAL	.882



CSS 340

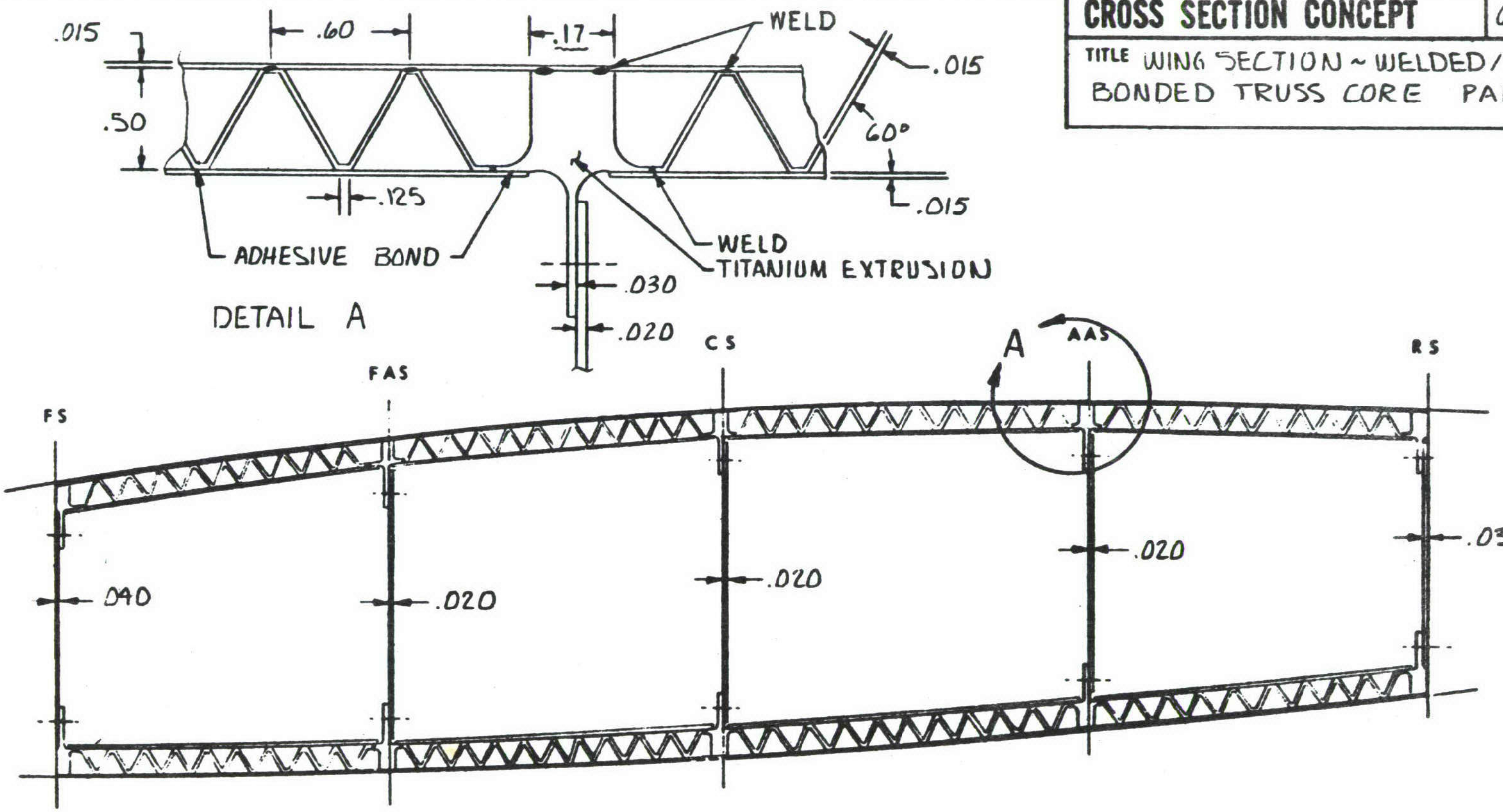
1/2 Scale

MATERIAL ~ 6AL-4V TITANIUM, ANNEALED

PREPARED BY J. D. Pinkler DATE 3/13/72

GENERAL DYNAMICS
Convair Aerospace Division
Fort Worth Operation

CROSS SECTION CONCEPT	610R-110
TITLE WING SECTION ~ WELDED/ADHESIVE BONDED TRUSS CORE PANELS	



MATERIAL ~ 6AL-4V TITANIUM, ANNEALED

CSS 340

1/2 Scale

PART	RAW STOCK WT.	FINISHED WT.
UPR SKIN	[illegible]	.270
LWR SKIN	[illegible]	[illegible]
SPARS	1.29	.292
TOTAL		[illegible]

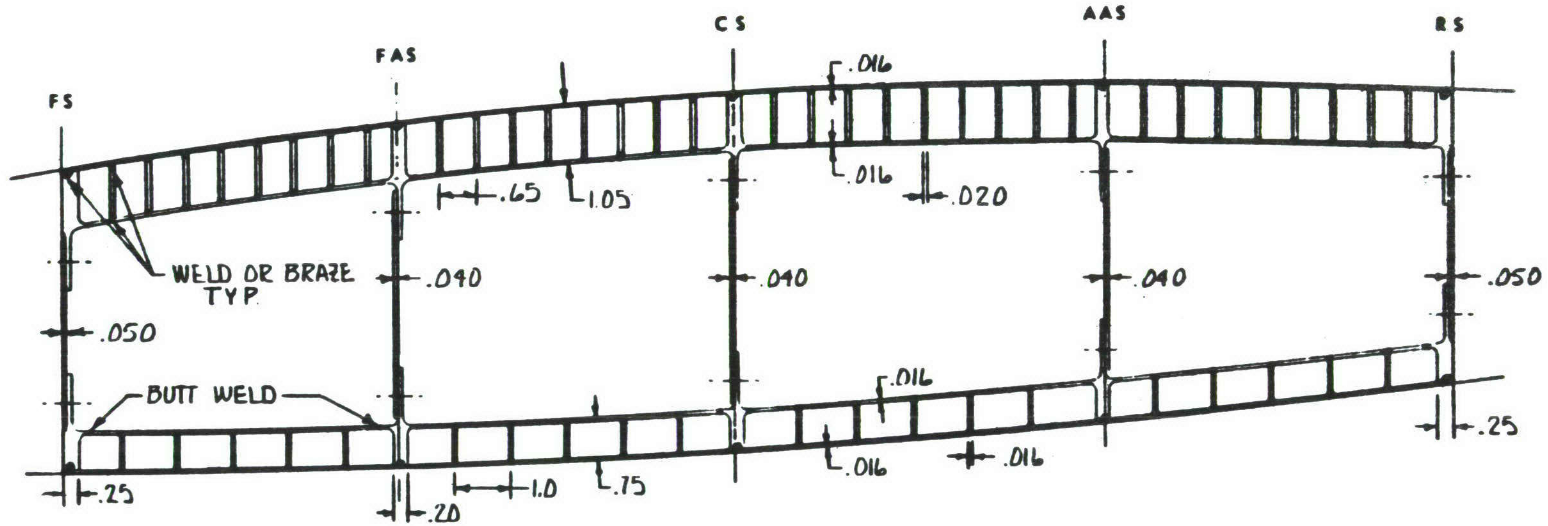
PREPARED BY J. D. [illegible] DATE 9/25/72

GENERAL DYNAMICS
Convair Aerospace Division
Fort Worth Operation

CROSS SECTION CONCEPT | 610R - 111

TITLE WING SECTION ~ RECTANGULAR TUBE PANELS, INTEGRAL SPAR CAP.

MATERIAL ~ 6AL-4V TITANIUM, ANNEALED



CSS 340

1/2 Scale

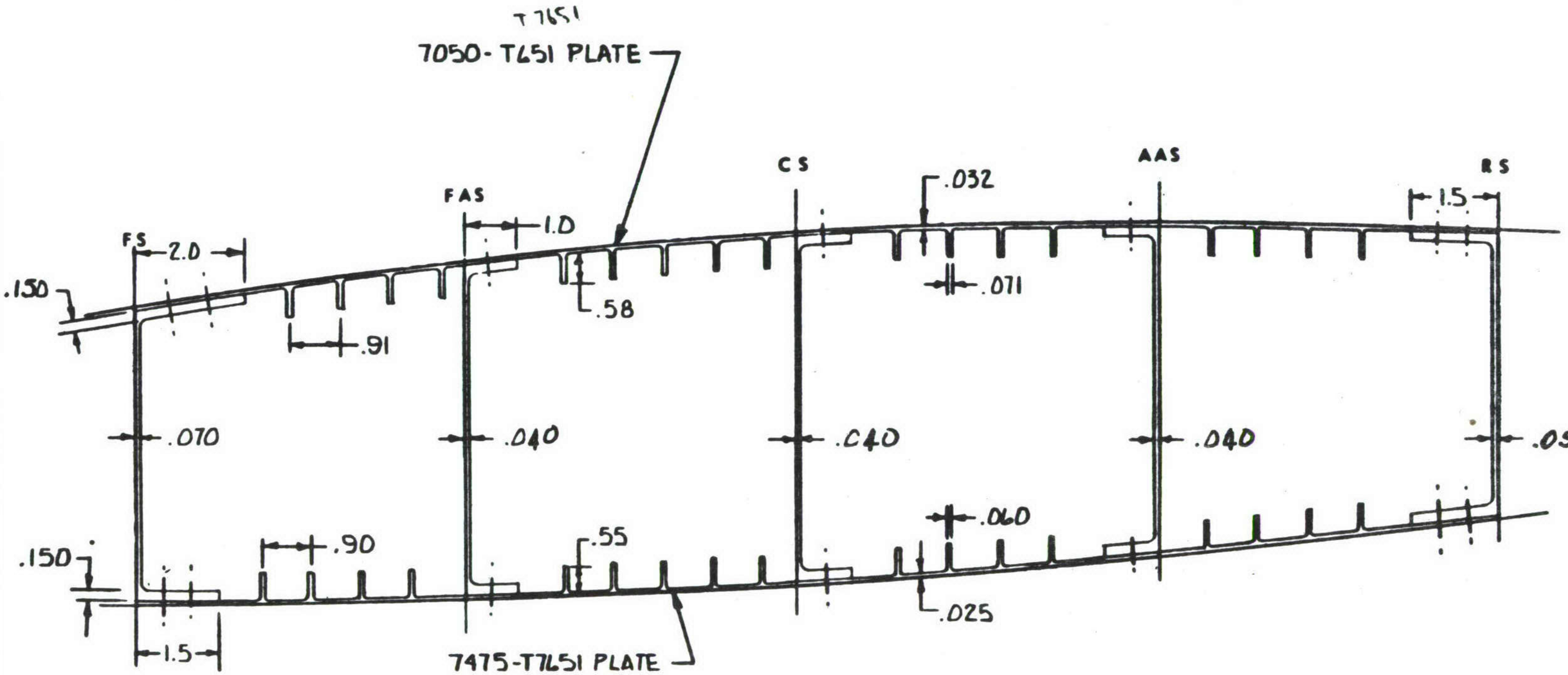
PART	RAW STOCK WT.	FINISHED WT.
UPPR SKIN	.28	.25
LWR SKIN	.22	.18
SPARS	.35	.28
TOTAL		.71

PREPARED BY J. D. Birler | DATE

GENERAL DYNAMICS
Convair Aerospace Division
Fort Worth Operation

CROSS SECTION CONCEPT	610R-112

TITLE WING SECTION ~ INTEGRAL BLADE STIFFENED ALUMINUM (CSS 340.0)



CSS 340

1/2 Scale

PART	RAW STOCK WT.	FINISHED WT.
UPPR SKIN	1.52	.20
LWR SKIN	1.52	.156
SPARS	3.74	.302
TOTAL		.658

PREPARED BY J.D. Bixler

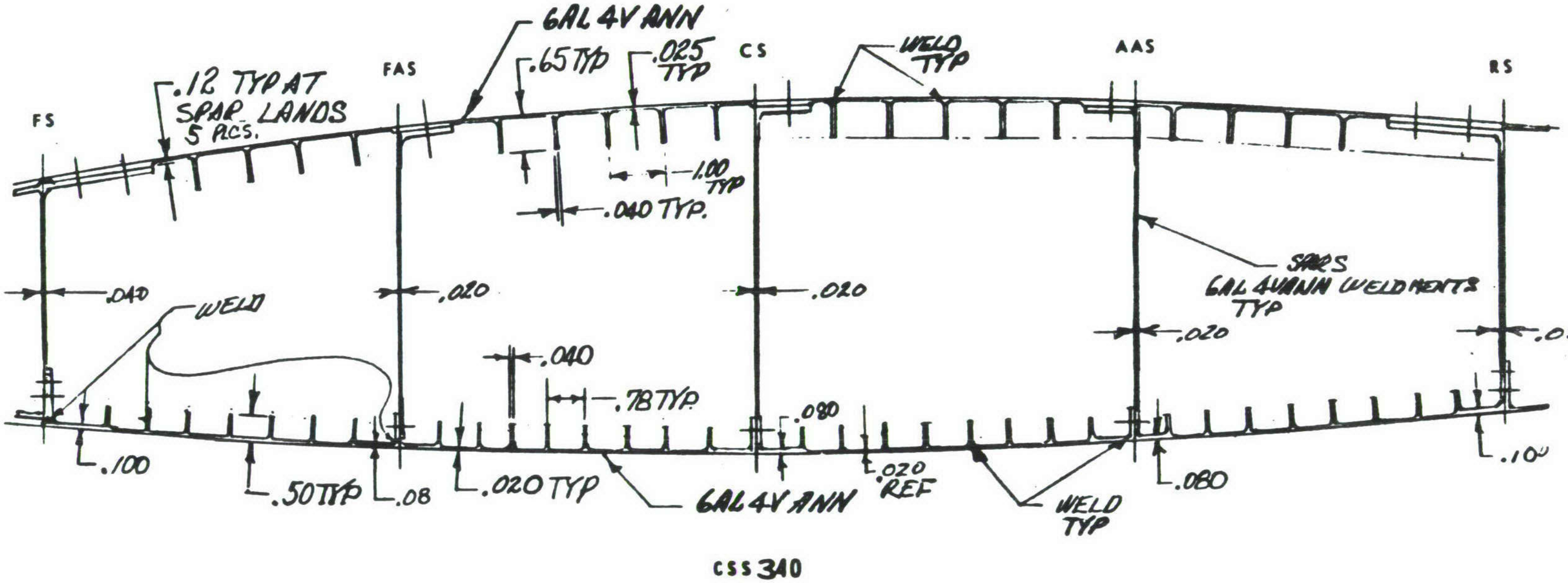
DATE

GENERAL DYNAMICS
Convair Aerospace Division
Fort Worth Operation

PART	RAW STOCK WT.	FINISHED WT.
UPPER SKIN	.80	.253
LOWER SKIN	.60	.182
SPARS	.60	.282
		.717

CROSS SECTION CONCEPT 610R-113 "A"

TITLE WING SECTION ~ WELDED BLADE STIFFENED TITANIUM (CSS 340.0)



CSS 340

PREPARED BY [signature] DATE 10-3-73

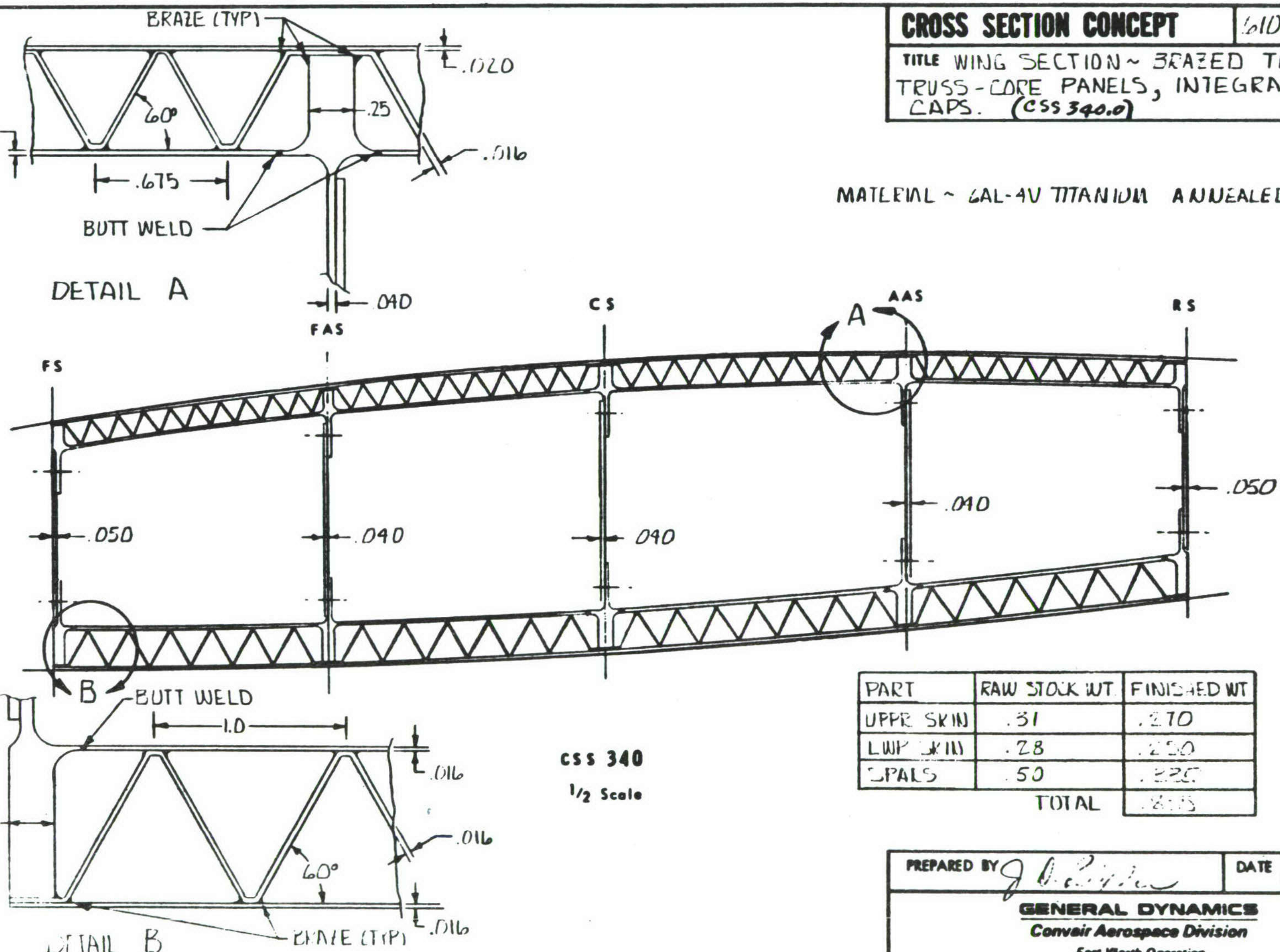
GENERAL DYNAMICS
Convair Aerospace Division
Fort Worth Operation

CROSS SECTION CONCEPT

61DR-114

TITLE WING SECTION ~ BRAZED TITANIUM TRUSS-CORE PANELS, INTEGRAL SPAR CAPS. (CSS 340.0)

MATERIAL ~ 6AL-4V TITANIUM ANNEALED



PART	RAW STOCK WT	FINISHED WT
UPPR SKIN	.31	.270
LWR SKIN	.28	.250
SPARS	.50	.220
	TOTAL	[illegible]

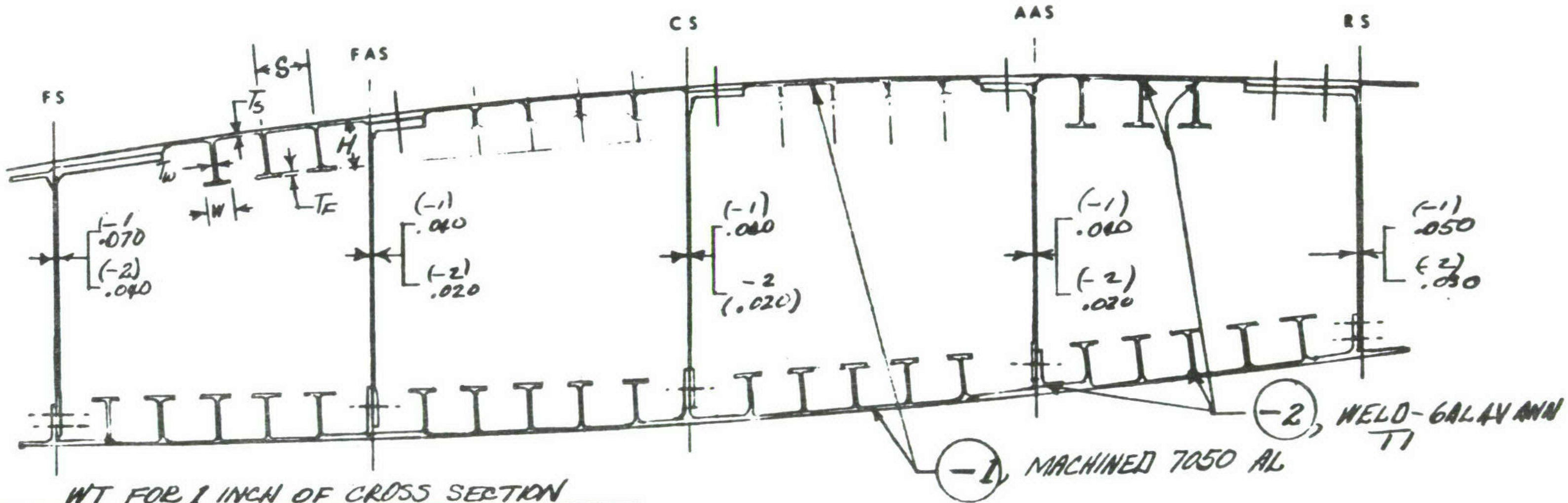
PREPARED BY J. A. [illegible] DATE 10/31/72

GENERAL DYNAMICS
Convair Aerospace Division
Fort Worth Operation

CROSS SECTION CONCEPT 610R 115

TITLE WING SECTION ~ INTEGRAL TEE STIFFENED SKINS (CSS 340.0)

DIMENSION	-1 (MATL. 7050 T651 AL)		-2 (6AL4V ANN. TI)	
	UPPER SKIN	LOWER SKIN	UPPER SKIN	LOWER SKIN
S	1.07	1.10	.94	1.25
T_F	.025	.020	.020	.020
T_S	.032	.025	.025	.025
T_W	.025	.020	.020	.020
W	.51	.50	.45	.500
H	.88	.88	.75	.75



WT FOR 1 INCH OF CROSS SECTION

PART	-1		-2	
	STK. WT	FIN. WT	STK. WT.	FIN. WT.
UPPER SKIN	3.0	.150	.80	.202
LOWER SKIN	3.0	.118	.72	.180
SPARS	4.6	.256	.35	.270
TOT. →		.524		.652

CSS 340

1/2 Scale

PREPARED BY [signature] DATE 10-3-72

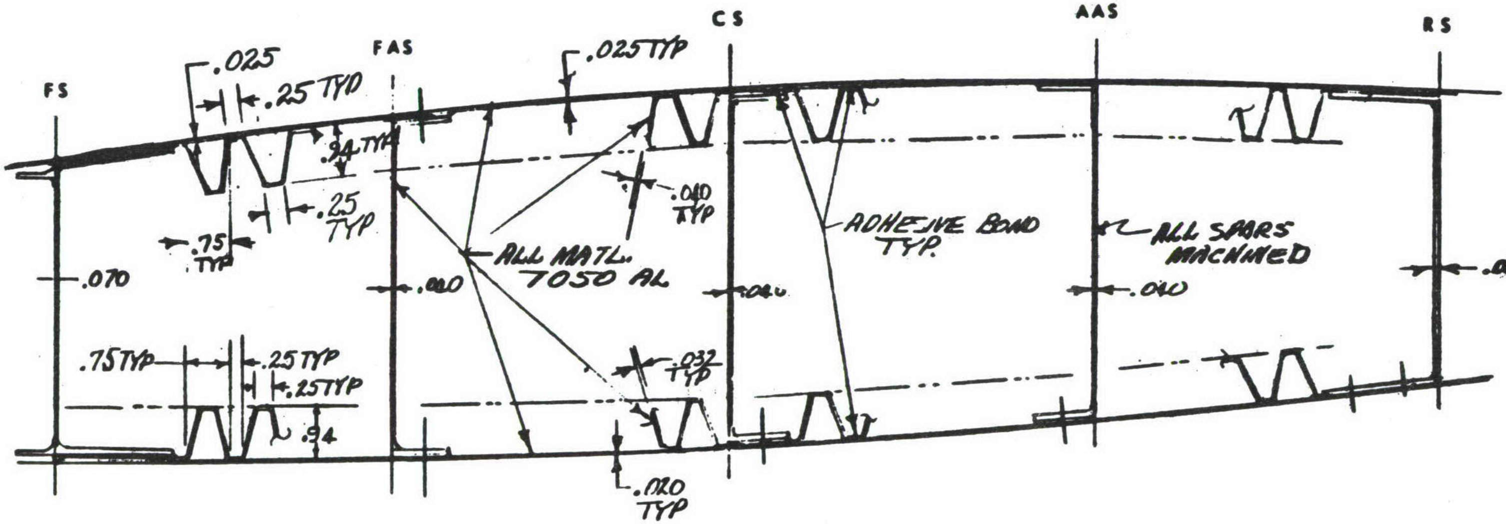
GENERAL DYNAMICS
Convair Aerospace Division
Fort Worth Operation

CROSS SECTION CONCEPT	610R-116
TITLE WING SECTION ~ ADHESIVE BONDED, CORRUGATED STIFFENER INNER SKIN (CSS 340.0)	

WTS. FOR 1" OF CROSS-SECTION

PART	STK. WT.	FIN. WT.
UPPER SKIN	.25	.204
LOWER SKIN	.25	.173
SPARS	4.6#	.259
		.636

NOTE: THIS CONFIGURATION MAY BE USED INBOARD OF CSS 340 ; REFER TO DWG. NO. 610R-030

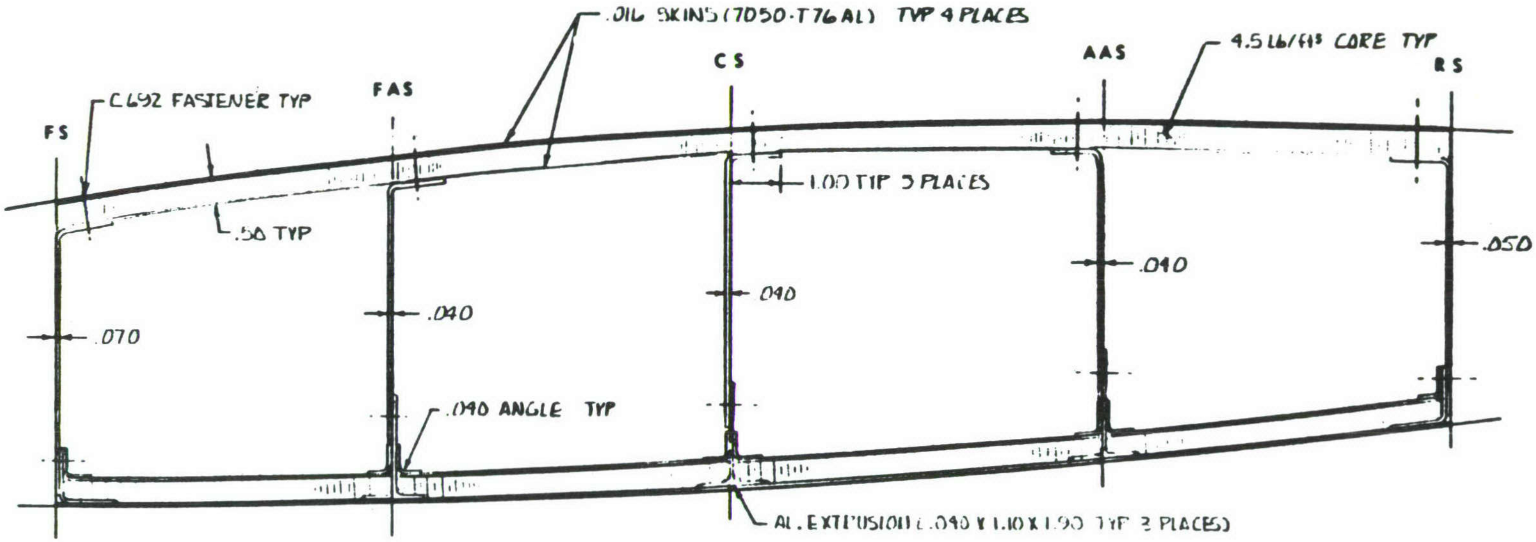


CSS 340

1/2 Scale

PREPARED BY	DATE 10-5-72
GENERAL DYNAMICS Convair Aerospace Division Fort Worth Operation	

CROSS SECTION CONCEPT	L10R-117
TITLE WING SECTION - FULL DEPTH SANDWICH SKIN PANELS, INTEGRAL LOWER SPAR CAPS	



PART	RAW STOCK WT.	FINISHED WT.
UPR SKIN	.200	.141
LWR SKIN	.310	.225
[illegible]	.175	.132
ADHESIVE	.100	—
	TOTAL	.438

CSS 340

1/2 Scale

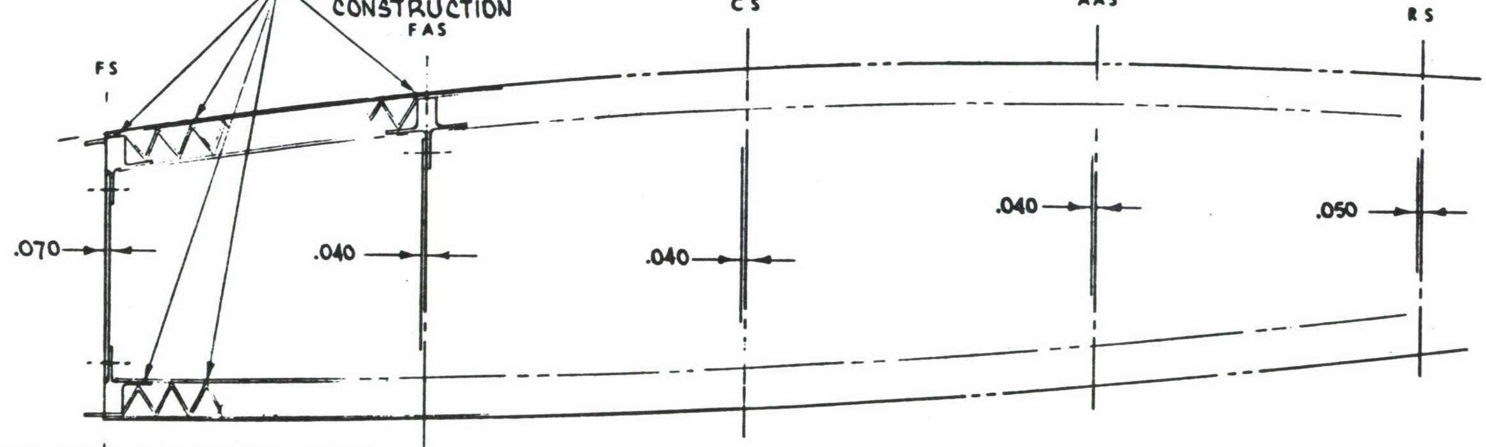
PREPARED BY [signature]	DATE 10/1/71
GENERAL DYNAMICS Convair Aerospace Division Fort Worth Operation	

CROSS SECTION CONCEPT	610R-118

TITLE WING SECTION – MODIFIED TRIANGULAR CORE, ADHESIVE BONDED ALUMINUM (CSS 340)

NOTE: THIS CONFIGURATION MAY BE USED INBOARD OF CSS 340; REFER TO DWG. NO. 610R-026

NOTE: • ALL SKINS, TRIANGULAR CORE AND SPAR WEBS ARE 7050-T76 ALUMINUM
• SPAR CAPS ARE 7050-T73651 ALUMINUM



WTS. FOR 1 INCH OF CROSS SECTION

PART	STOCK WT.	FINISHED WT.
Upper Panel	.34	.28
Lower Panel	.29	.24
Spars	.50	.30
	TOTAL	.82

CSS 340

1/2 Scale

NOTE: REFER TO DWG. NO. 610R-026 (AT CSS 140) FOR DETAILS OF CONSTRUCTION

PREPARED BY A. E. Bloom DATE 10-26-72

GENERAL DYNAMICS
Convair Aerospace Division
Fort Worth Operation

WEIGHTS FOR 1 INCH OF CROSS SECTION

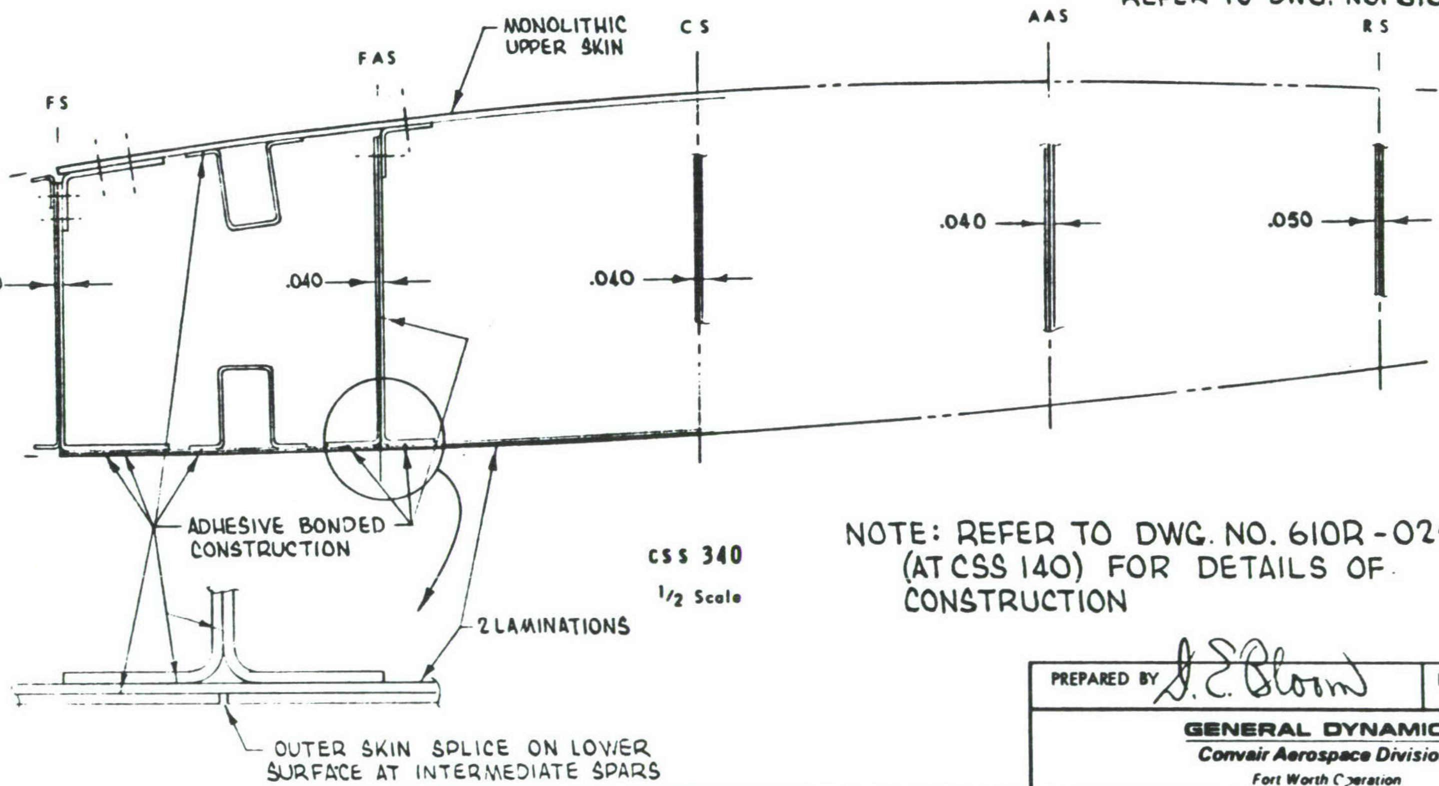
PART	STOCK WT.	FINISHED WT.
Upper Panel	0.22	0.18
Lower Panel	0.20	0.17
Spars	0.36	0.30
	TOTAL	0.65

CROSS SECTION CONCEPT 610R-119

TITLE WING SECTION - ADHESIVE BONDED HAT STIFFENERS ; 7050 ALUMINUM (CSS 340)

NOTE : • ALL MATERIAL IS 7050 ALUMINUM

• THIS CONFIGURATION MAY BE USED INBOARD OF CSS 340; REFER TO DWG. NO. 610R-025



CSS 340

1/2 Scale

NOTE: REFER TO DWG. NO. 610R-025 (AT CSS 140) FOR DETAILS OF CONSTRUCTION

PREPARED BY S. E. Bloom DATE 10-27-72

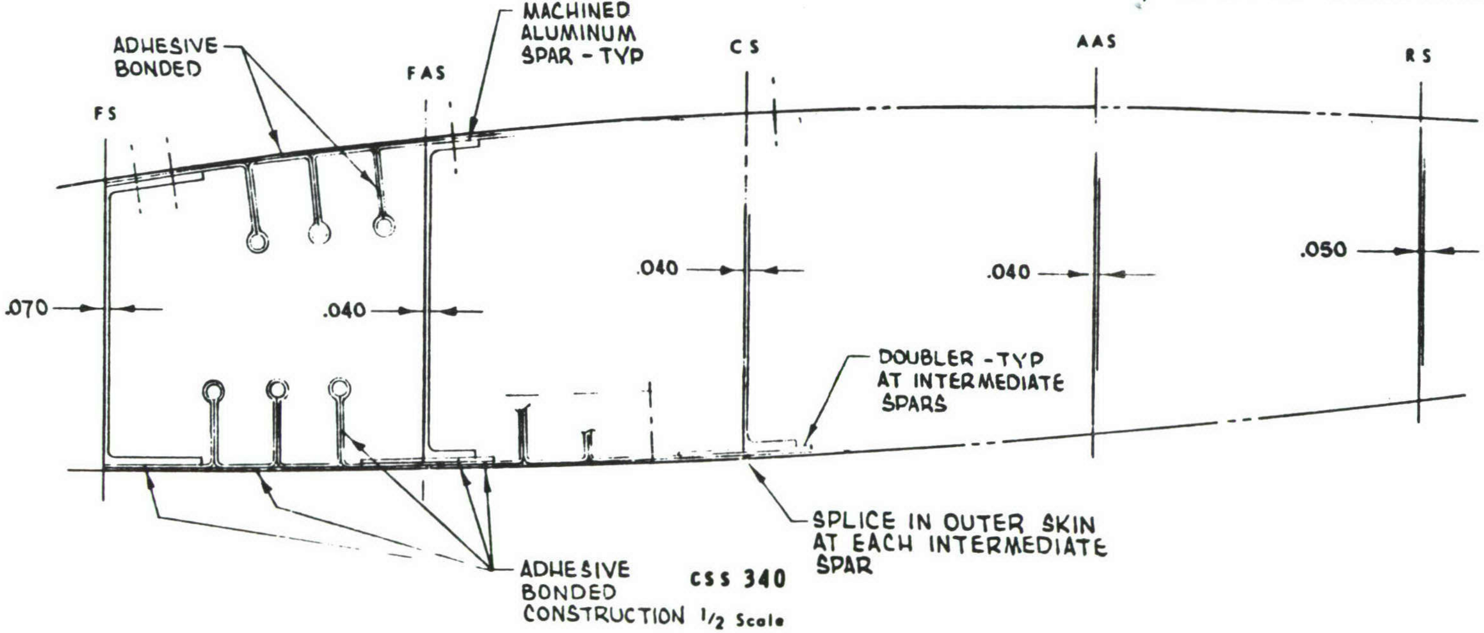
GENERAL DYNAMICS
Convair Aerospace Division
Fort Worth Operation

CROSS SECTION CONCEPT	610R-120
TITLE WING SECTION - INTEGRAL FORMED BULB TEE (CSS 340)	

WEIGHTS FOR 1 INCH OF CROSS SECTION

PART	STOCK WTS.	FINISHED WTS.
Upper Panel	0.24	0.20
Lower Panel	0.19	0.16
Spars	4.05	0.30
		0.66

NOTES:
- ALL MATERIAL IS 7050 ALUMINUM
- REFER TO DWG. NO. 610R-019 FOR DETAILS OF CONSTRUCTION
- THIS CONFIGURATION MAY BE USED INBOARD OF CSS 340; REFER TO DWG. NO. 610R-019



PREPARED BY J. E. Olsson DATE 10-27-72

GENERAL DYNAMICS
Convair Aerospace Division
Fort Worth Operation

APPENDIX III

ANALYTICAL ASSEMBLY DRAWINGS

III.1 SUMMARY

During the third step of the Concept Formulation Phase, twenty-three (23) Analytical Assembly drawings and two (2) baseline Analytical Assembly drawings at C.S.S. 140.0 and C.S.S. 340.0 were completed. These Analytical Assemblies were based on top ranking cross-section concepts which were evaluated during the second step of this Phase. The cross-section concepts are described in Appendix II, PHASE SUMMARY, CROSS-SECTION DRAWINGS.

Evaluation of the twenty-five (25) Analytical Assembly drawings was based on a numerical Rating System. The revised rating system plan is shown in Table XIX. Details of the rating system and description of how the numerical values were generated are discussed in Appendix II. A summary of the analytical assembly evaluation is shown in Table XX and Table XXI.

III.2 EVALUATION AND RANKING

The evaluation and ranking of each concept is an important part of the design approach used in this program. The object of this system is to remove personnel opinion which may influence a design to insure that each discipline area has an opportunity to influence the design rating.

II.2.1 Rating System Review

The rating system used in evaluating and ranking the analytical assembly drawings is identical to that used for the cross-section concepts except for rating values for structural integrity. A complete discussion of the approach used to implement the rating system is contained in Appendix II, "Cross-Section Drawings". The revised rating values for structural integrity changed safe crack growth from 0.2 to 0.3 and multiple load with from 0.4 to 0.3. Multiple load path was also redesignated as Fail Safe. The basic elements of the revised rating system are shown in Table XIX.

III.2.2 Evaluation of Concepts

During the Analytical Assembly part of the concept Formulation Phase of this program, twenty-three (23) analytical assembly drawings and two (2) baseline analytical assembly

Table XIX

RATING SYSTEM FOR THE ANALYTICAL ASSEMBLY DRAWINGS**
ADVANCED AIR SUPERIORITY FIGHTER WING STRUCTURES PROGRAM

STRUCTURAL EFFICIENCY = 0.3	TECHNOLOGY ADVANCEMENT = 0.3	INTEGRITY AND RELIABILITY = 0.3	ABILITIES = 0.1
Cost = 0.5	Concepts = 0.3	Static = 0,1	Inspectability = 0.5
Weight = 0.5	Manufacturing = 0.3	Fatigue = 0.3	Manufacturability = 0.2
	Materials = 0.3	Safecrack = 0.3	Maintainability = 0.1
	Fracture = 0.1	Fail Safe = 0.3	Repairability = 0.1
			Predictability = 0.1

* Service Life maintained at 4000 flight hours. Any design not maintaining this life will be considered unacceptable.
** Revised rating system Jan 1973.

Table XX

ANALYTICAL ASSY. CONCEPTS CSS 140.0
EVALUATION SUMMARY

CONFIG. NO.	DESCRIPTION	STRUCT. EFFICIEN.		TECHNOLOGY ADVANCEMENT				STRUCT. INTEGRITY RELIABILITY				ABILITIES					TOTAL SCORES	RANK
		COST (.15) See Note 1	WEIGHT (.15)	CONCEPT TECH (.09)	MFG'G TECH (.09)	MATL'S TECH (.09)	FRACT. TECH (.03)	STATIC (.03)	FATIGUE QUALITY (.09)	SAFE CRACK (.09)	FAIL SAFE (.09)	INSPECT (.05)	MFG (.02)	MAIN-TAIN (.01)	REPAIR (.01)	PREDICT (.01)		
610RA000	F111F BASELINE	$ 2985.68 .146	384.89 lbs .076	.009	0	0	.012	.029	.041	.039	0	.050	..02	.010	.010	.0039	.4459	14
610RA001	WING-MULTI-WET CELL CONSTR. (TI)	7215.31 .060	195.00 .150	.090	.0824	.072	.024	.017	.087	.073	.025	.0344	.0122	.0071	.0056	.0061	.7458	4
610RA002	BRAZED SANDWICH TRUSS CORE SKINS (TI)	11,035.44 .0390	219.78 .133	.050	.0900	.036	.024	.017	.085	.073	.057	.0375	.0116	.0098	.0097	.0036	.6762	8
610RA003	LAMINATED LOWER SKIN STEP'D CAPS SAND. UPR. (AL)	4554.84 .096	283.90 .103	.063	.0354	.036	.024	.017	.088	.088	.090	.039	.0124	.0084	.009	.0058	.7150	5
610RA004	AL HONEYCOMB UPR SKIN, TI BLADE STIFF - LWR SRN	9576.07 .045	249.94 .117	.058	.0584	.09	.024	.017	.089	.073	.025	.037	.0124	.0071	.0076	.0051	.6431	11
610RA005	ADH BOND - HAT STIFF. UPR (AL)	3018.58 .144	300.88 .097	.054	.0348	.054	.024	.017	.090	.088	.090	.031	.0132	.0097	.009	.0029	.7586	2
610RA006	LAMINATED LWR SKIN - PLATE UPR - (AL)	3343.74 .130	296.94 .099	.086	.0231	.054	.024	.017	.088	.088	.090	.0375	.0160	.0097	.009	.0061	.7774	1
610RA007	ADH. BOND LAM. SKINS HAT STIFF. (TI)	9476.66 .046	246.17 .119	.072	.0328	.090	.024	.017	.089	.073	.041	.039	.0102	.0089	.0083	.0038	.6740	10
610RA008	BRAZED SPACE TRUSS WING (TI)	14,967.16 .029	200.94 .146	.086	.0748	.054	.024	.017	.085	.073	.041	.0355	.0128	.0073	.0070	.0076	.7000	6
610RA009	MODIFIED TRIAG. CORE-ADH. BOND AL	4777.44 .091	300.00 .098	.054	.0260	.036	.024	.017	.086	.088	.082	.0360	.0135	.0097	.0090	.0046	.6748	9
610RA010	AL HONEYCOMB SKINS INTEG. SPAR CAPS	2902.10 .150	293.06 .100	.081	.0167	.054	.030	.017	.088	.088	.049	.0398	.0145	.0092	.010	.0017	.7489	3
610RA011	INTEGRAL FORMED BULB-TEE STIFF (TI)	8346.75 .0521	239.70 .122	.054	.0492	.054	.024	.017	.087	.073	.041	.03225	.0110	.0091	.0063	.0057	.6376	12
610RA012	SAND SKINS-INTEGRAL SPARS (TI)	7043.06 .0618	239.92 .1218	.072	.0246	.072	.030	.017	.089	.073	.041	.0413	.0124	.0095	.0097	.010	.6851	7
610RA013	AL HONEYCOMB UPR SKIN - 6-4 TI ANNEALED BLADE LWR	6761.02 .064	267.36 .1052	.058	.0368	.054	.024	.030	.049	.090	.025	.0365	.0128	.0071	.0076	.0051	.6051	13

Note 1. Cost figures are for evaluation purposes only and do not include General and Administrative, Engineering, Material burden, allocations, etc.

Table XXI

ANALYTICAL ASSY CONCEPTS CSS 340.0
EVALUATION SUMMARY

CONFIG. NO.	DESCRIPTION	STRUCT. EFFICIENCY COST (.15) See Note 2	STRUCT. EFFICIENCY WEIGHT (.15)	TECHNOLOGY ADVANCEMENT CONCEPT TECH (.09)	TECHNOLOGY ADVANCEMENT MFG. TECH (.09)	TECHNOLOGY ADVANCEMENT MATL'S TECH (.09)	TECHNOLOGY ADVANCEMENT FRACT TECH (.03)	STRUCT INTEGRITY-RELIABILITY STATIC (.03)	STRUCT INTEGRITY-RELIABILITY FATIGUE QUALITY (.09)	STRUCT INTEGRITY-RELIABILITY SAFE CRACK (.09)	STRUCT INTEGRITY-RELIABILITY FAILSAFE (.09)	ABILITIES INSPECT (.05)	ABILITIES MFG. (.02)	ABILITIES MAIN-TAIN (.01)	ABILITIES REPAIR (.01)	ABILITIES PREDICT (.01)	TOTAL SCORE	RANK
610RA100	F111F BASELINE @ CSS 340.0	$1846.01 .133	69.17 lbs .0538	.011	0.0	0	.012	.017	.058	.032	0	.050	.0165	.010	.010	.0051	.4084	10
610RA101	ADH BONDED-HAT STIFF SKINS (AL)	2146.90 .114	51.12 .0728	.045	.0326	.067	.030	.007	.020	.021	0	.0325	.0175	.0084	.0083	.0080	.4841	7
610RA102	SAND SKIN PANELS INT LWR SPAR CAPS (AL)	2713.00 .0905	39.84 .0935	.045	.0218	.067	.030	.007	.024	.037	.045	.0455	.0177	.0079	.0090	.0071	.5480	4
610RA103	ADH BONDED CLOSE SPAR SPACE (AL)	2052.01 .1193	24.81 .150	.09	.0457	.045	.024	.008	.027	.043	.090	.029	.020	.0051	.0057	.0084	.7102	1 5
610RA104	INTEGRAL FORMED BULB TEE (AL)	2622.89 .0936	40.75 .0913	.067	.047	.090	.030	.006	.020	.017	0.0	.0205	.0142	.0072	.0057	.0100	.5195	5
610RA105	WING-MULTI-WET CELL CONSTR. (TI)	3805.64 .0646	33.97 .110	.09	.090	.023	.024	.014	.072	.028	0.0	.0345	.0145	.0058	.0057	.0084	.5845	3
610RA106	MODIFIED TRIANGLE CORE (AL)	1631.24 .1500	60.27 .0618	.0562	.0174	.045	.030	.030	.086	.090	0.0	.0295	.0189	.0092	.010	.0051	.6391	5 2
610RA107	ADH. BOND-CORRUGT'D INNER SKINS (AL)	2172.61 .1128	48.72 .0764	.0338	.01622	.045	.030	.005	.013	.014	0.0	.0325	.0173	.0083	.0077	.0090	.4270	8
610RA108	RECTANG. TUBE PANELS INT. S.CAPS (TI)	See Note 1	41.59 .0852	.0450	See Note 1	0.0	.018	.012	.024	.031	0.0	.0380	See Note 1	.0062	.0077	.0014	See Note 1	11
610RA109	MULTIPLE TEN. STRAP WELD'D STIFF (TI)	2661.74 .0922	48.39 .0768	.023	.060	0.0	.018	.016	.036	.040	0.0	.0365	.0146	.0069	.0077	.0051	.4328	9
610RA110	DIAG. TENSION WIRE SYSTEM	2047.16 .1194	39.34 .0948	.045	.013	.045	.030	.012	.029	.035	0.0	.0415	.0123	.0060	.0063	.0030	.4923	6

Note 1. Not economically feasible to manufacture

Note 2. Cost figures are for evaluation purposes only and do not include General and Administrative, Engineering, Material burden, allocations, etc.

drawings were made. These drawings are included in Section III.3. The evaluation of these designs is discussed below and is summarized in Table XX and XXI.

III.2.2.1 Structural Efficiency

The weight and cost totals and the evaluation score for each analytical assembly are shown in Table XX (C.S.S. 140) and Table XXI (C.S.S. 340). The work sheets with cost and weight breakdowns are shown in Section IV.4. The weight and cost values are based on a 48 inch span.

To assure that cost data for each analytical assembly was comparable, the following costing ground rules were established:

- o 1972 rates were used. No escalation factors were used.
- o Unit cost was based on a total aircraft production of 506 at a rate of 20/month.
- o No general and administrative costs or profit were added.
- o No engineering costs were included.
- o Material costs used were unburdened (i.e., no factors were applied for incoming freight, allocations, etc.).
- o Standard costs were used regardless of the assembly being considered to prevent any distortion of final results.
- o Baseline analytical assemblies were estimated using above ground rules and without regard to any of the costs, factors, and learning curves used to provide the baseline costs in Appendix VII.

III.2.2.2 Technology Advancement

To enable a thorough evaluation of each Analytical Assembly for Technology Advancement, a chart was prepared showing the results of each area within Technology Advancement, and the total Technology Advancement Score. Values for Assemblies at C.S.S. 140 are shown in Table XXII, and values for Assemblies at C.S.S. 340 are shown in Table XXIII.

Table XXII

EVALUATION SUMMARY WORKSHEET

TECHNOLOGY ADVANCEMENT

CSS 140.0

ASSEMBLY NO.	CONCEPT TECH. (.09)		MFG'S TECH (.09)	MATL's TECH (.09)		FRACTURE TECH (.03)		TOTAL (.30)
610RA000	10	.009	0	0		40	.012	.0210
610RA001	100	.090	.0824	80	.072	80	.024	.2684
610RA002	55.6	.050	..0900	40	.036	80	.024	.2000
610RA003	70.0	.063	.0354	40	.036	80	.024	.1584
610RA004	64.4	.058	.0584	100	.09	80	.024	.2304
610RA005	60	.054	.0348	60	.054	80	.024	.1668
610RA006	95	.086	.0231	60	.054	80	.024	.1871
610RA007	80	.072	.0328	100	.090	80	.024	.2188
610RA008	95	.086	.0748	60	.054	80	.024	.2388
610RA009	60	.054	.0260	40	.036	80	.024	.1400
610RA010	90	.081	.0167	60	.054	100	.030	.1817
610RA011	60	.054	.0492	60	.054	80	.024	.1812
610RA012	80	.072	.0246	80	.072	100	.030	.1986
610RA013	64.4	.058	.0368	60	.054	80	.024	.1728

Table XXIII

EVALUATION SUMMARY WORKSHEET
TECHNOLOGY ADVANCEMENT
CSS 340.0

ASSEMBLY NO.	CONCEPT TECH.		MFG'S TECH. (.09)	MATL'S TECH. (.09)		FRACTURE TECH. (.03)		TOTAL (.30)
610RA100	12.5	.011	0	0		40	.012	.023
610RA101	50	.045	.0326	75	.067	100	.030	.1746
610RA102	50	.045	.0218	75	.067	100	.030	.1638
610RA103	100	.09	.0457	50	.045	80	.024	.2047
610RA104	75	.067	.047	100	.090	100	.030	.2340
610RA105	100	.09	.090	25	.023	80	.024	.2270
610RA106	67	.0562	.0174	50	.045	100	.030	.1486
610RA107	37.5	.0338	.0162	50	.045	100	.030	.1250
610RA108	50	.0450	0	0		60	.018	.0630
610RA109	25	.023	.060	0		60	.018	.1010
610RA110	50	.045	.013	50	.045	100	.030	.1330

A portion of Technology Advancement is Manufacturing Technology. The worksheets used to evaluate Analytical Assemblies for Manufacturing Technology are shown in Section III.5.

III.2.2.3 Integrity and Reliability

The evaluation results of Analytical Assemblies for "Integrity and Reliablity" have been organized into Table XXIV (C.S.S. 140) and Table XXV (C.S.S. 340) to assist in the evaluation.

III.2.2.4 Abilities

The charts containing the results of evaluation of "Abilities" are shown in Table XXVI (C.S.S. 140) and Table XXVII (C.S.S. 340). An important segment accounting for one-half of the "Ability" rating is "Inspectability". The detail work sheets used for Inspectability evaluation are shown in Section III.6.

III.2.3 Ranking of Concepts

The results of all the evaluations discussed in paragraph III.2.2 were tabulated in Tables XX and XXI. The results of the evaluation for each element of the rating system were added together to obtain a Total Score. The Assemblies were ranked numerically with the highest score ranked as number 1.

III.2.4 Preliminary Design

The concepts with the highest scores were chosen for use during Preliminary Design, the fourth step in the Design Approach being used in this program. Assemblies chosen for preliminary design are identified in Tables XX and XXI by circling the rank number. Additionally, certain Assemblies were chosen for design (trade studies) of splicing two different designs (inboard and outboard) together. These Assemblies are identified with an 's' by the rank number.

Table XXIV

EVALUATION SUMMARY WORKSHEET

INTEGRITY-RELIABILITY

CSS 140.0

ASSEMBLY NO.	STATIC (.03)	FATIGUE QUALITY (.09)	SAFE CRACK GROWTH (.09)	FAIL SAFE (.09)	TOTALS (.30)
610RA000	.029	.041	.039	0	.109
610RA001	.017	.087	.073	.025	.202
610RA002	.017	.085	.073	.057	.232
610RA003	.017	.088	.088	.090	.283
610RA004	.017	.089	.073	.025	.204
610RA005	.017	.090	.088	.090	.285
610RA006	.017	.088	.088	.090	.283
610RA007	.017	.089	.073	.041	.220
610RA008	.017	.085	.073	.041	.216
610RA009	.017	.086	.088	.082	.273
610RA010	.017	.088	.088	.049	.242
610RA011	.017	.087	.073	.041	.218
610RA012	.017	.089	.073	.041	.220
610RA013	.030	.049	.090	.025	.194

Table XXV

EVALUATION SUMMARY WORKSHEET

INTEGRITY-RELIABILITY

CSS 340.0

ASSEMBLY NO.	STATIC	FATIGUE QUALITY	SAFE CRACK GROWTH	FAIL SAFE	TOTAL
610RA100	.017	.058	.032	0	.107
610RA101	.007	.020	.021	0	.048
610RA102	.007	.024	.037	.045	.113
610RA103	.008	.027	.043	.090	.168
610RA104	.006	.020	.017	0	.043
610RA105	.014	.072	.028	0	.114
610RA106	.030	.086	.090	0	.206
610RA107	.005	.013	.014	0	.032
610RA108	.012	.024	.031	0	.067
610RA109	.016	.036	.040	0	.092
610RA110	.012	.029	.035	0	.076

Table XXVI

EVALUATION SUMMARY WORKSHEET

ABILITIES

CSS 140.0

ASSEMBLY NO.	INSPECT (.05)	MANUF. (.02)	MAINTAIN (.01)	REPAIR (.01)	PREDICT (.01)	TOTAL (.1)
610RA000	.050	.02	.010	.010	.0039	.0939
610RA001	.0344	.0122	.0071	.0056	.0061	.0593
610RA002	.0375	.0116	.0098	.0097	.0036	.0686
610RA003	.039	.0124	.0084	.009	.0058	.0746
610RA004	.037	.0124	.0071	.0076	.0051	.0692
610RA005	.031	.0132	.0097	.009	.0029	.0658
610RA006	.0375	.0160	.0097	.009	.0061	.0783
610RA007	.039	.0102	.0089	.0083	.0038	.0702
610RA008	.0355	.0128	.0073	.0070	.0076	.0702
610RA009	.0360	.0135	.0097	.0090	.0046	.0728
610RA010	.0398	.0145	.0092	.010	.0017	.0752
610RA011	.0322	.0110	.0091	.0063	.0057	.0643
610RA012	.0413	.0124	.0095	.0097	.010	.0829
610RA013	.0365	.0128	.0071	.0076	.0051	.0691

Table XXVII

EVALUATION SUMMARY WORKSHEET

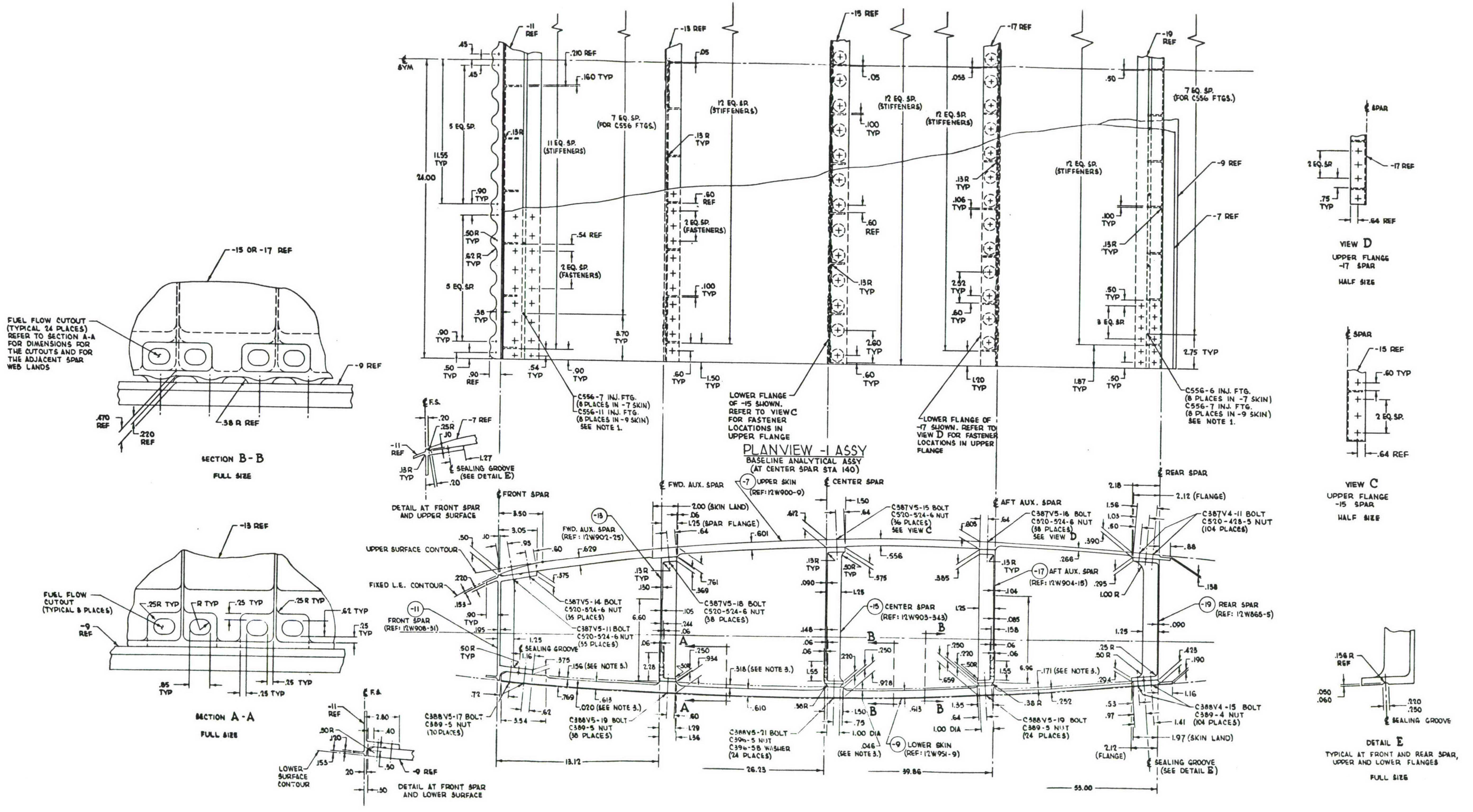
ABILITIES

CSS 340.0

ASSEMBLY NO.	INSPECT (.05)	MANUF (.02)	MAINTAIN (.01)	REPAIR (.01)	PREDICT (.01)	TOTAL (.1)
610RA100	.050	.0165	.010	.010	.0051	.0916
610RA101	.0325	.0175	.0084	.0083	.0080	.0747
610RA102	.0455	.0177	.0079	.0090	.0071	.0872
610RA103	.029	.020	.0051	.0057	.0084	.0682
610RA104	.0205	.0142	.0072	.0057	.010	.0576
610RA105	.0345	.0145	.0058	.0057	.0084	.0689
610RA106	.0295	.0189	.0092	.010	.0051	.0727
610RA107	.0325	.0173	.0083	.0077	.0090	.0748
610RA108	.0380	---	.0062	.0077	.0014	---
610RA109	.0365	.0146	.0069	.0077	.0051	.0708
610RA110	.0415	.0123	.0060	.0063	.0030	.0691

SECTION III.3

ANALYTICAL ASSEMBLY DRAWINGS



ANALYTICAL ASSEMBLY - CONCEPT DATA SUMMARY																			610RA000
DASH NO.	PART NAME	NO. REQD	RAW STOCK SIZE	RAW STOCK WT.	MATL.	MATL PROP APPLICABLE TO CRIT. STRESS	STATIC LIMIT DES STRESS ($F = {}^{15.5}/_{RS}$)	MAX. OPERATING STRESS	K_T	ALLOW FATIGUE STRESS	FRACT TOUGH K_{IC} KSI$\sqrt{in}$	K_{ISCC}	DAM. TOL. CLASS	INSPECTABILITY CLASS	CRIT. CRACK LENGTH TYPE	MIN. NDI DETECT. CRACK LENGTH METH	ALLOW. FRACT. STRESS	FIN. WEIGHT IN LBS.	COST IN DOLLARS
-7	UPPER SKIN	1	1×54×60	324.00	2024-T851 QQ-A-250/4													130.68	397.76
-9	LOWER SKIN	1	1×54×60	324.00	2024-T851 FMS-1010	F_{tu} = 66 KSI	F = 21.25 KSI (16.9)	16.9 KSI	2.7		23		SLOW CRACK GROWTH	NON INSPECTABLE	.385 BOLT HOLE THRU THE THICKNESS		16.9 KSI	176.44*	352.27
-11	FRONT SPAR	1	4.3×9.5×54	220.59	↓													18.25	534.30
-13	FWD. AUX. SPAR	1	1.6×10.6×54	91.58	↓													11.62	185.40
-15	CENTER SPAR	1	1.8×11.7×54	113.72	↓													11.62	223.35
-17	AFT AUX. SPAR	1	1.6×11.5×54	99.36	↓													11.08	199.95
-19	REAR SPAR	1	2.5×10.5×54	141.75	2024-T851 FMS-1010													12.42	258.08
C387V4-11	BOLT	104			TI													.39	610.06
C387V5-11	BOLT	35			TI													.52	
C387V5-14	BOLT	35			TI													.60	
C387V5-15	BOLT	36			TI													.64	
C387V5-16	BOLT	38			TI													.70	
C387V5-18	BOLT	38			TI													.76	
C388V4-15	BOLT	104			TI													1.14	
C388V5-17	BOLT	70			TI													.84	
C388V5-19	BOLT	62			TI													.81	
C388V5-21	BOLT	24			TI													.37	
C389-4	NUT	104			STL													.33	
C389-5	NUT	132			STL													.90	
C396-5 / C396-58	NUT / WASHER	24			STL													.39	
C520-428-5	NUT	104			STL													.71	
C520-524-6	NUT	182			STL													2.00	
C556-6	INJ. FTG.	8			TI													.04	
C556-7	INJ. FTG.	16			TI													.08	
C556-11	INJ. FTG.	8			TI													.06	
-1	ANALYTICAL ASSY																		224.65
																	TOTAL	384.89	2985.68

*SEE NOTES 3. AND 4.

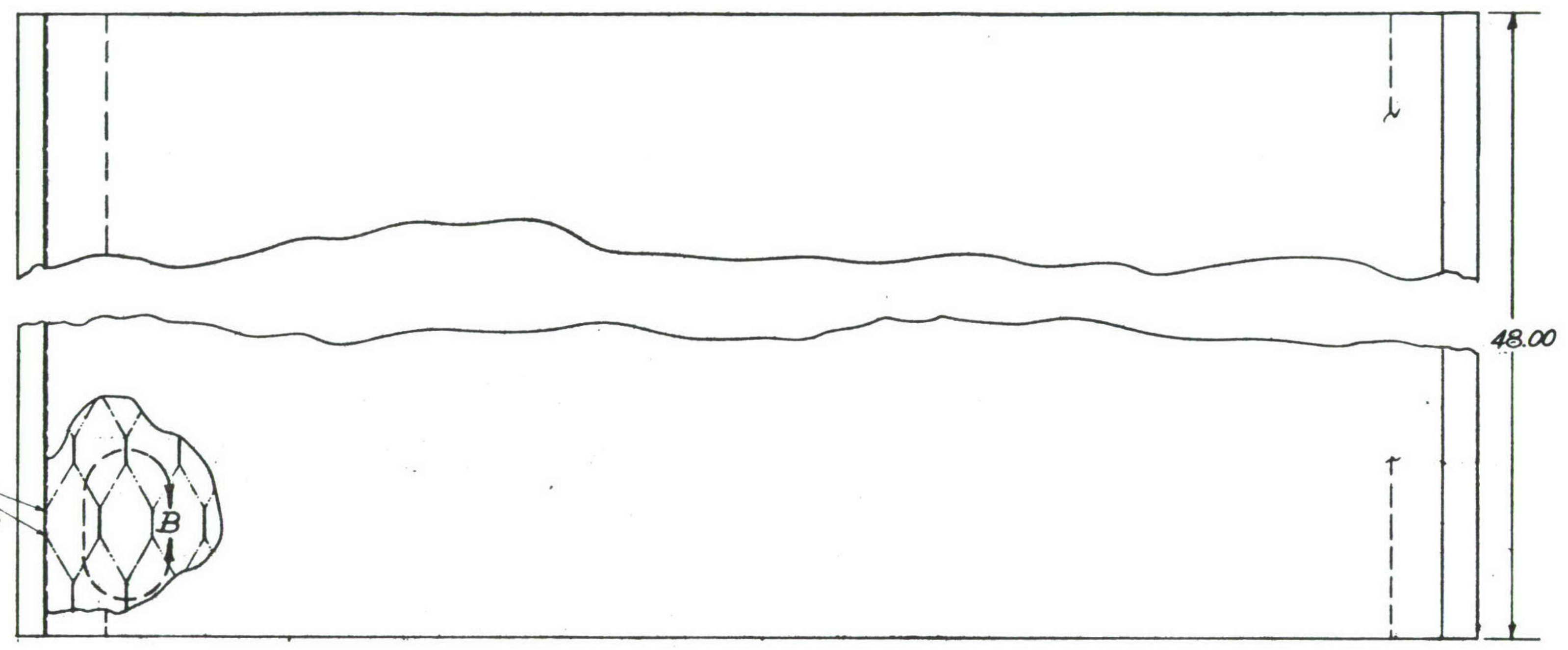
4. THE FINISHED WEIGHT FOR THE -9 LOWER SKIN INCLUDES A WEIGHT OF 40.51 POUNDS OVER THE WEIGHT OF THE BASELINE SKIN DESIGN REQUIRED TO SATISFY THE DAMAGE TOLERANCE CRITERIA.
3. THIS DIMENSION REPRESENTS THE INCREASE IN SKIN THICKNESS, OVER THE ORIGINAL BASELINE LOWER SURFACE SKIN, REQUIRED TO SATISFY THE "USAF DAMAGE TOLERANCE CRITERIA", REVISION D, PROPOSED FOR MIL-A-8866 (B) (USAF).
2. THE FAYING SURFACES AT THE FRONT AND REAR SPARS, AND ALL FASTENERS, SHALL BE SEALED PER FPS-1004.
1. INSTALL C556 INJECTION FITTINGS PER M076 EQUALLY SPACED BETWEEN FASTENERS AS SHOWN AND CENTERED ON THE SEALING GROOVE. PLUG WITH NAS 1081-06A3 SCREWS.

NOTES:

PRELIMINARY DESIGN DRAWING
ANALYTICAL ASSEMBLY - BASELINE CONFIGURATION, MACHINED ALUMINUM
CSS 140.00
GENERAL DYNAMICS
Convair Aerospace Division
Fort Worth Operation
610RA000
SHEET 1 OF 1

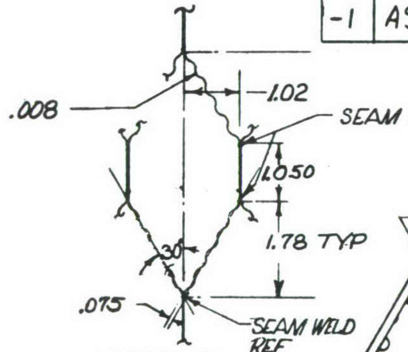
DASH NO	PART NAME	NO REQ'D	RAW STOCK SIZE	RAW STOCK WEIGHT LBS	MATL	MAT'L PROPS APPLICABLE TO CRIT. STRESS	STATIC LIN. DES STRESS (F x 155/195)	MAX. OPER. STRESS	K_T	ALLOW FATIGUE STRESS	FRACT. TOUGH. K KSI√in	K_{ISC}	DAM TOL. CLASS	INSPECTABILITY CLASS	CRIT. CRACK LENGTH / TYPE	MIN. NDI DETECT. CRACK LEN / METH	ALLOW. FRACT STRESS	FIN. WT. IN LBS.	COST IN DOLLARS
-7	UPPER SKIN	1	.175 x 60 x 54	84.0	6Al-4V STA	F_c = 155 KSI	F = 103 KSI (82 KSI)	82 KSI		—						.15/U.T. PEN.	—	71.2	1,612.78
-9	LOWER SKIN ASSY	1	(3) x .052 x 60 x 54.0	81.5	8-8-2-3 TI	F_{tu} = 175	F = 116.5 (92.5)	92.5 KSI	1.0	>92.5 SEE NOTE 1	80		F.S.	DEPOT INSPECTABLE	.335 SURFACE FLAW	.15/UT. PEN	103 KSI	68.8	2,150.95
-11	F/S UPPER CAP	1	EXTR x 54.0 (1.00 in²)	16.8	8-8-2-3 TI											.15/UT. PEN, X-RAY		3.14	235.85
-13	R/S UPPER CAP	1	EXTR x 54.0 (1.62 in²)	16.3	8-8-2-3 TI											.15/UT, PEN, X-RAY		2.08	221.62
-15	F/S LOWER CAP	1	EXTR x 54.0 (.36 in²)	2.18	8-8-2-3 TI											.15/U.T., PEN, X-RAY		1.86	102.72
-17	R/S LOWER CAP	1	EXTR. x 54.0 (.36 in²)	2.18	8-8-2-3 TI											.15/U.T. PEN, X-RAY		1.92	102.92
-19	F/S WEB	1	.032 x 6.0 x 49	1.65	8-8-2-3 TI	F_{su} = 108	F = 66 (52.5)	52.5 PURE SHEAR	3.0	—						.15/UT PEN, X-RAY	—	1.39	31.27
-21	R/S WEB	1	.025 8.0 x 49	1.71	8-8-2-3 TI	F_{su} = 108	F = 41.3 (32.8)	32.8 PURE SHEAR	3.0	—						.15/UT PEN, X-RAY	—	1.57	36.13
-23	MULTI-CELL ASSY	1	52 pcs. .008 x 13 x 60	5.20	COMM. PURE TI											.15/UT, PEN, X-RAY		37.8	749.42
-25	ANGLE	1	.080 x 2.5 x 50	1.75	8-8-2-3 TI													1.68	26.48
-27	ANGLE	1	.080 x 2.3 x 50	1.61	8-8-2-3 TI													1.55	24.42
✓	LOW TEMP BRAZE ALLOY	2 pcs	.003 x 50 x 64	3.88	TX-21													3.69	183.87
-1	ASS'Y																	-	1,749.88
																		195.2	7,215.31

1/31/78

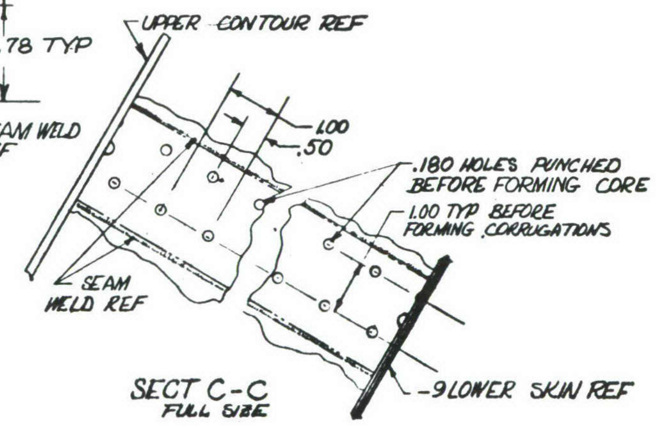


TACK WELD -23 ASSY TO SPAR THRU THIN FILM BRAZE ALLOY TX-21, TYP FRONT & REAR SPARS

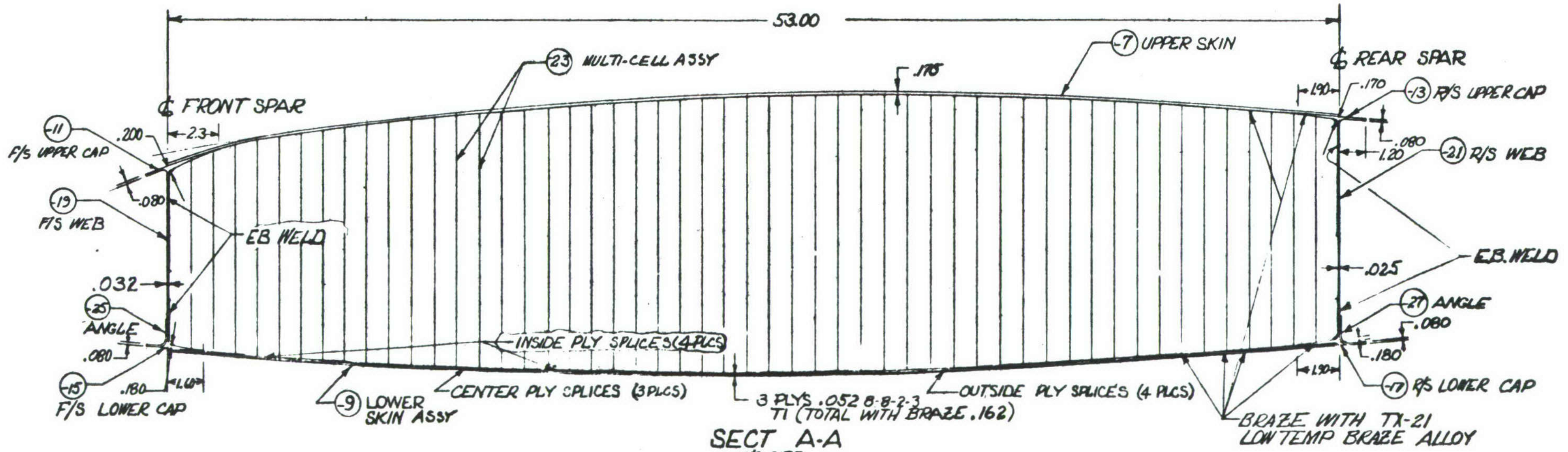
PLAN VIEW
1/2 SIZE



VIEW B



SECT C-C
FULL SIZE



SECT A-A
1/2 SIZE

NOTES:

(1) VALUE SHOWN IS ASSUMED TO BE EQUAL TO OR MORE THAN PENDING TEST RESULTS

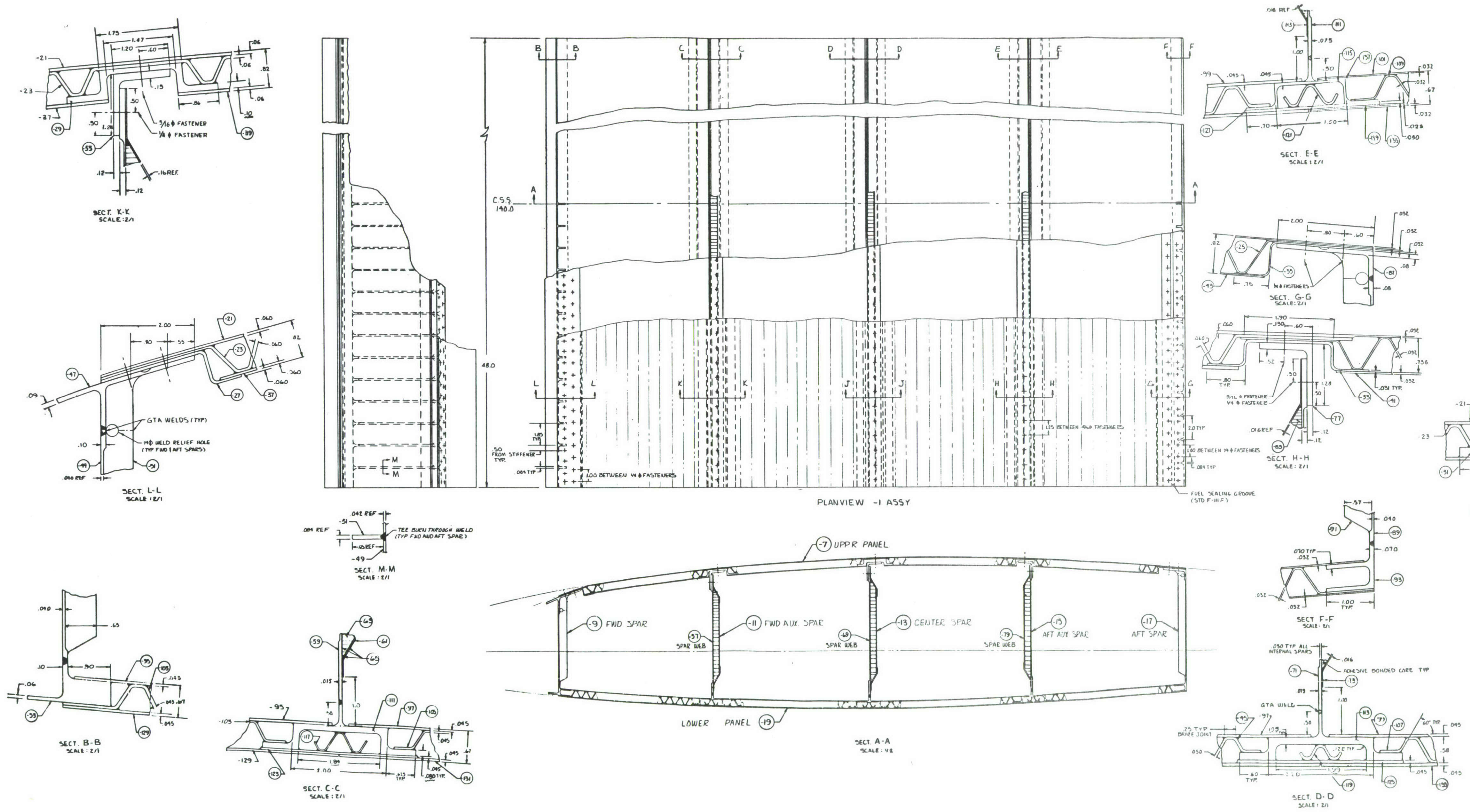
PRELIMINARY DESIGN DRAWING

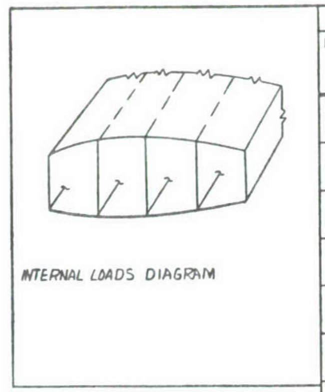
ANALYTICAL ASSY ~ WING - MULTI - WET CELL CONSTRUCTION (CSS 140.0)

GENERAL DYNAMICS
Convair Aerospace Division

610RA001

12-15-72





ANALYTICAL ASSY~ CONCEPT DATA SUMMARY — 610RA002

DASH NO.	PART NAME	NO. REQD	RAW STOCK SIZE	RAW STOCK WEIGHT	MAT'L	MATL PROPS APPLICABLE TO CRIT STRESS	STATIC LIMIT DES STRESS	MAX. OPERATING STRESS	K_T	ALLOW FATIGUE STRESS	FRACT TOUGH K_c	K_{ISCC}	DAM TOL CLASS	INSPECT-ABILITY CLASS	CRIT CRACK LENGTH	MIN NDI DETECT CRACK LEN	ALLOW FRACT STRESS	FIN. WT IN LBS.	COST IN DOLLARS
-7	UPPR PANEL	1	SEE TABLE BELOW	158.7	6AL-4V STA	F_{ty} = 154 KSI										.100 UT X-RAY		87.06	4,750.82
-9	FWD SPAR	1		78.6	6AL-4V ANN.											.150 PEN., UT, X-RAY		11.53	894.63
-11	FWD. AUX SPAR	1		15.1	SEE TABLE BELOW	F_{tu} = 175 KSI	F = 107.5 KSI (85.5)	85.5 KSI	3.0	>85.5 KSI SEE NOTE 1								10.03	247.48
-13	CENTER SPAR	1		16.2														10.42	264.40
-15	AFT AUX SPAR	1		17.0	SEE TABLE BELOW													9.93	278.40
-17	AFT SPAR	1		29.2	6AL-4V ANN											.150 PEN., UT, X-RAY		9.08	641.73
-19	LOWER PANEL	1	SEE TABLE BELOW	185.7	8-8-2-3 STA	F_{tu} = 175	F = 116.5 (92.5)	92.5 KSI	1.0	>92.5 SEE NOTE 1	80.		F.S.		.335 SURFACE FLAW	.100 UT, X-RAY	102.5 KSI	81.71	2,383.38
-1	ASSY	-	-	-	-														3,574.37
																		219.78	11,095.44

DASH NO.	PART NAME	NO. REQD	RAW STOCK SIZE	RAW STOCK WEIGHT	MAT'L	DASH NO.	PART NAME	NO. REQD	RAW STOCK SIZE	RAW STOCK WEIGHT	MAT'L
-7	UPPR. PANEL	1	—	(165.7)	—	-77	UPPER CAP	1	[illegible]	2.8	6AL-4V STA
-21	OUTER SKIN	1	.060 X 53 X 48	24.5	6AL-4V STA	-79	WEB	1	—	(14.2)	—
-23	CORRUGATED HEAVY CORE	1	.060 X 82 X 48	33.0	6AL-4V STA	-81	THICK SKIN	1	[illegible]	11.0	8-8-2-3 STA
-25	CORRUGATED LIGHT CORE	1	.032 X 27 X 48	12.5	6AL-4V STA	-83	THIN SKIN	1	[illegible]	1.6	8-8-2-3 STA
-27	INTEGRAL SLUG, FWD SPAR	1	.06 X 4 X 48 FORM.	1.3	6AL-4V STA	-85	CORE	1	[illegible]	0.6	4.5 #/cu ft
-29	INTEGRAL SLUG, FWD AUX SPAR	1	3.5 X 7.5 X 48 EXTR	20.0	6AL-4V STA	-65	ADHESIVE	AR	[illegible] X 48	1.0	FMS 1013
-31	INTEGRAL SLUG, CTR SPAR	1	3.75 X 7.5 X 48 EXTR	21.3	6AL-4V STA	-17	AFT SPAR	1	—	(29.2)	—
-33	INTEGRAL SLUG, AFT AUX SPAR	1	3.5 X 7.5 X 48 EXTR	20.0	6AL-4V STA	-87	UPPER CAP	1	[illegible] X 48	3.2	6AL-4V ANN.
-35	INTEGRAL SLUG, AFT SPAR	1	.032 X 4 X 48 FORM	1.0	6AL-4V STA	-89	WEB	1	—	(26.0)	—
-37	INNER SKIN, 1	1	.060 X 10.5 X 48	4.8	6AL-4V STA	-91	STIFFENER	23	[illegible]	18.5	6AL-4V ANN.
-39	INNER SKIN, 2	1	.060 X 10.5 X 48	4.8	6AL-4V STA	-93	LOWER CAP	1	[illegible] X 48	7.7	6AL-4V ANN
-41	INNER SKIN, 3	1	.060 X 11 X 48	5.1	6AL-4V STA	-19	LOWER PANEL	1	—	(185.7)	—
-43	INNER SKIN, 4	1	.032 X 10.5 X 48	2.6	6AL-4V STA	-95	INNER SKIN, 1	1	.050 X 13 X 48	6.5	8-8-2-3 STA
-45	LOW TEMPERATURE BRAZE ALLOY	AR	—	1.8	TX-21	-97	INNER SKIN, 2	1	.050 X 13 X 48	6.5	8-8-2-3 STA
-9	FWD. SPAR	1	—	(78.6)	—	-99	INNER SKIN, 3	1	.050 X 13 X 48	6.5	8-8-2-3 STA
-47	UPPER CAP	1	1 X 3.5 X 48	27.0	6AL-4V ANN.	-101	INNER SKIN, 4	1	.032 X 13 X 48	3.5	8-8-2-3 STA
-49	WEB	1	0.150 X 6.5 X 48	7.5	6AL-4V ANN	-103	CORRUGATED CORE, 1	1	[illegible] X 25 X 48	12.6	8-8-2-3 STA
-51	STIFFENER	25	0.071 X 7 X 6.5	15.5	6AL-4V ANN	-105	CORRUGATED CORE, 2	1	.050 X 24 X 48	12.1	8-8-2-3 STA
-53	LOWER CAP	1	.70 X 3.75 X 48	23.9	6AL-4V ANN	-107	CORRUGATED CORE, 3	1	.050 X 26 X 48	13.1	8-8-2-3 STA
-11	FWD. AUX. SPAR	1	—	(15.1)	—	-109	CORRUGATED CORE, 4	1	[illegible]	7.5	8-8-2-3 STA
-55	UPPER CAP	1	[illegible] X 48 EXTR	2.9	6AL-4V STA	-111	INTEGRAL SLUG, 1	1	[illegible] X 48 EXTR	27.4	8-8-2-3 STA
-57	WEB	1	—	(12.2)	—	-113	INTEGRAL SLUG, 2	1	[illegible] X 48 EXTR	29.4	8-8-2-3 STA
-59	THICK SKIN	1	.12 X 13 X 48	9.2	8-8-2-3 STA	-115	INTEGRAL SLUG, 3	1	[illegible] X 48 EXTR	29.4	8-8-2-3 STA
-61	THIN SKIN	1	.016 X 13 X 48	1.4	8-8-2-3 STA	-117	SLUG STIFFENER, 1	1	[illegible]	1.5	8-8-2-3 STA
-63	CORE	1	.5 X 9 X 48	0.6	4.5 #/cu ft	-119	SLUG STIFFENER, 2	1	[illegible]	1.5	8-8-2-3 STA
-65	ADHESIVE	AR	20 X 48	1.0	FMS 1013	-121	SLUG STIFFENER, 3	1	[illegible]	1.5	8-8-2-3 STA
-13	CENTER SPAR	1	—	(16.2)	—	-123	SHIM, 1	1	[illegible] X 48	1.4	8-8-2-3 STA
-67	UPPER CAP	1	[illegible] X 48 EXTR	3.1	6AL-4V STA	-125	SHIM, 2	1	[illegible] X 48	1.5	8-8-2-3 STA
-69	WEB	1	—	(13.1)	—	-127	SHIM, 3	1	[illegible] X 48	1.5	8-8-2-3 STA
-71	THICK SKIN	1	.12 X 11 X 48	10.0	8-8-2-3 STA	-129	OUTER SKIN, 1	1	[illegible] X 48	5.5	8-8-2-3 STA
-73	THIN SKIN	1	.016 X 12 X 48	1.5	8-8-2-3 STA	-131	OUTER SKIN, 2	1	[illegible] X 48	5.5	8-8-2-3 STA
-75	CORE	1	.5 X 9 X 48	0.6	[illegible]	-133	OUTER SKIN, 3	1	[illegible] X 48	5.9	8-8-2-3 STA
-65	ADHESIVE	AR	20 X 48	[illegible]	[illegible]	-135	OUTER SKIN, 4	1	[illegible] X 48	3.5	8-8-2-3 STA
-15	AFT AUX SPAR	1	—	(17.0)	—	-45	LOW TEMPERATURE BRAZE ALLOY	AR	—	1.8	TX-21
						-137	THIN SHIM, INNER	1	[illegible] X 48	0.2	8-8-2-3 STA
						-139	THIN SHIM, OUTER	1	[illegible] X 48	0.5	8-8-2-3 STA

NOTES:
1. VALUE ASSUMED PENDING TEST RESULTS

FASTENERS

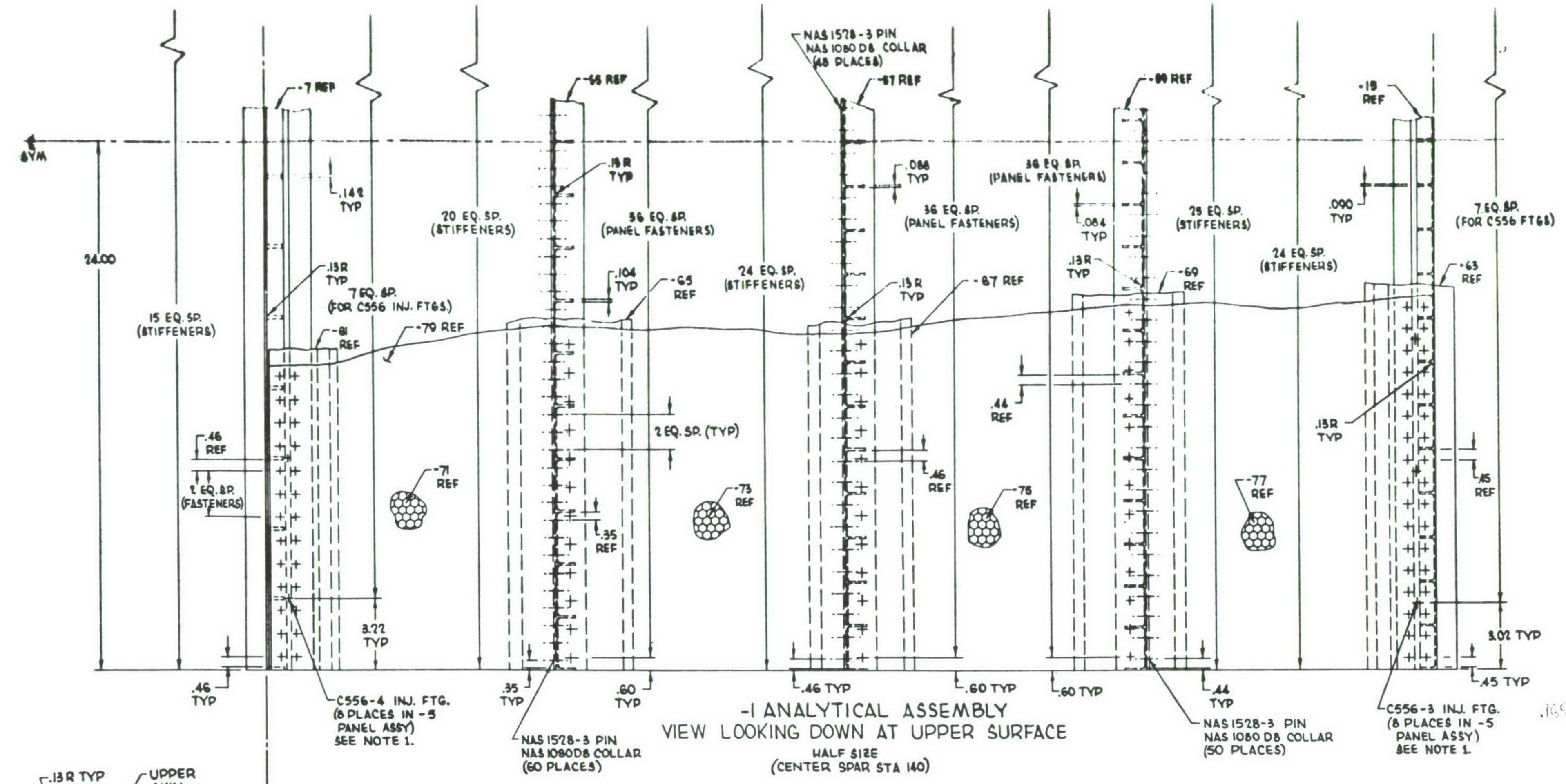
NAME	DESIGNATION	NO.	COST
BOLT	C387 V4-11	342	
BOLT	C387-V5-11	120	
NUT	C399-4	342	
NUT	C399-5	120	

PRELIMINARY DESIGN DRAWING

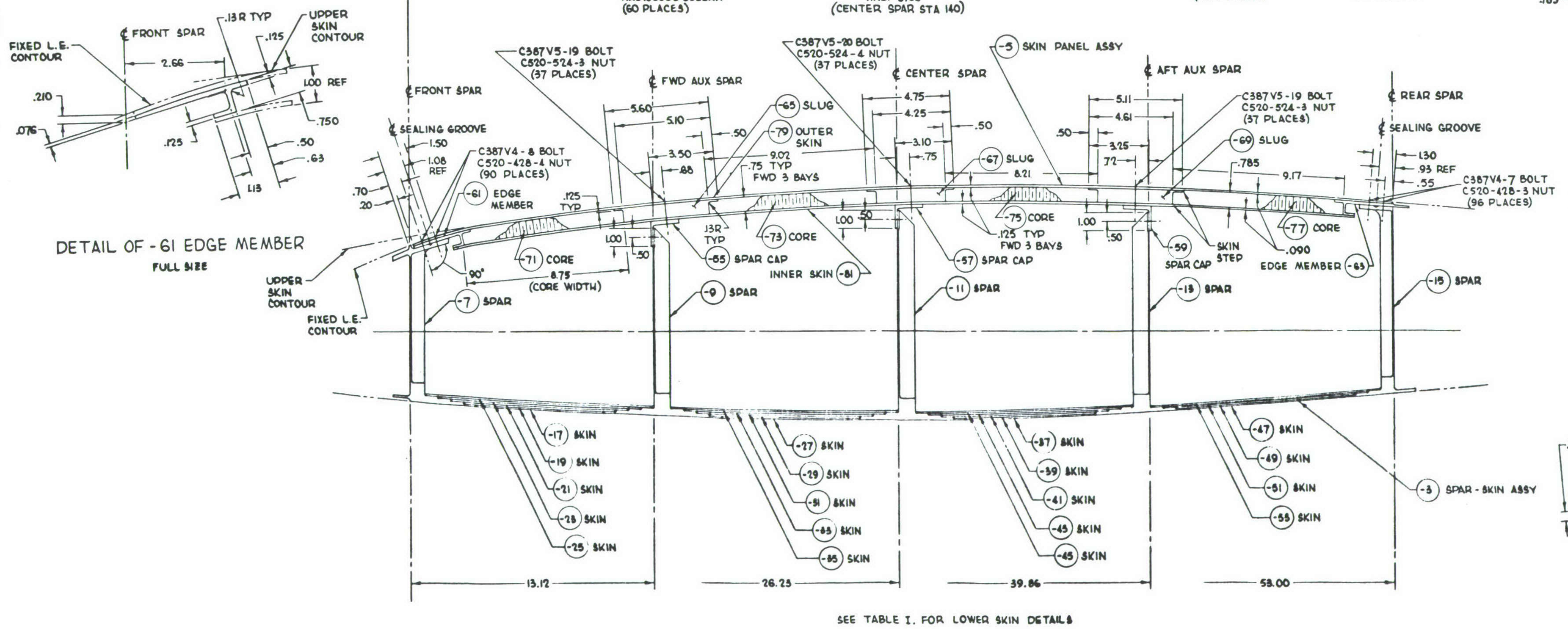
BRAZED SANDWICH SKINS WITH TRUSS MEMBER CORE - TITANIUM (C.S.S. 140.0)

GENERAL DYNAMICS
Convair Aerospace Division

610RA002



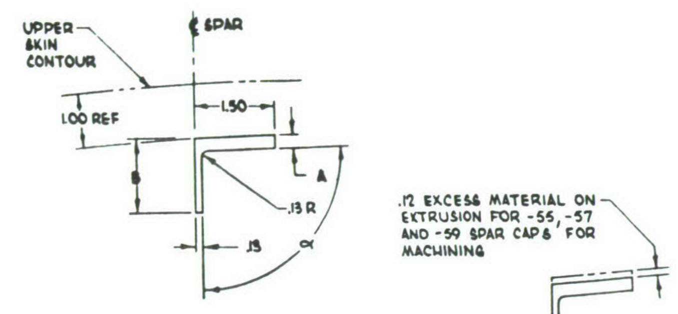
-1 ANALYTICAL ASSEMBLY
VIEW LOOKING DOWN AT UPPER SURFACE
HALF SIZE
(CENTER SPAR STA 140)



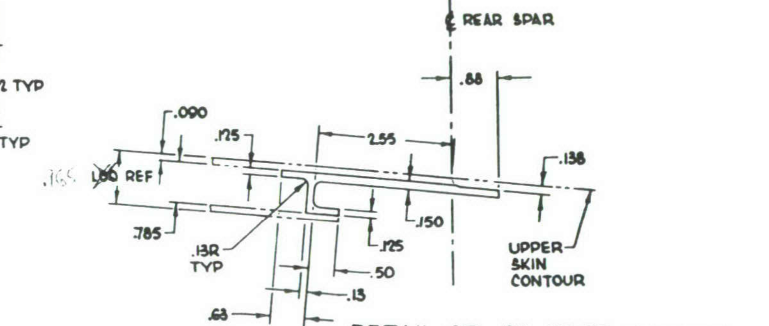
DETAIL OF -61 EDGE MEMBER
FULL SIZE

SEE TABLE I. FOR LOWER SKIN DETAILS

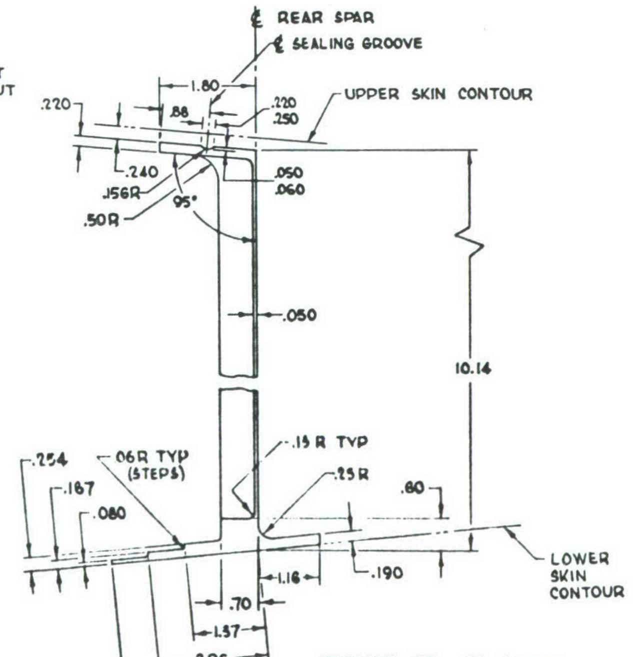
DASH NO.	"A"	"B"	α
-55	.11	1.34	95°
-57	.15	1.38	91°30'
-59	.21	1.34	92°30'



DETAIL OF -55, -57 AND -59 SPAR CAPS
FULL SIZE



DETAIL OF -63 EDGE MEMBER
FULL SIZE



DETAIL OF -15 SPAR
FULL SIZE

-1 ANALYTICAL ASSEMBLY - CONCEPT DATA SUMMARY																		610RA003
DASH NO.	PART NAME	NO. REQD	RAW STOCK SIZE	RAW STOCK WT.	MATL.	MATL PROPS APPLICABLE TO CRITICAL STRESS	STATIC LIMIT DES STRESS ($F = {}^{15}/_{115}$)	MAX OPERATING STRESS	K_T	ALLOW. FATIGUE STRESS	FRACT TOUGH K_c KSI√IN	DAM. TOL CLASS	INSPECTABILITY CLASS	CRIT. CRACK LENGTH —TYPE	MIN NDI DETECT. CRACK LENGTH METH	ALLOW. FRACT. STRESS	FINISHED WEIGHT IN LBS.	COST IN DOLLARS
-3	SPAR SKIN ASSY	1	-	-	-										.120/MM UT			
-7	FRONT SPAR	1	47×97×54	246.19	7050-T7 AL ALLOY	F_{tu} = 71.8 KSI											15.09	347.38
-9	FWD AUX SPAR	1	EXTRU×54 (19.8 IN²)	99.04	AL EXTRU	F_{tu} = 71.8 KSI	F = 46.1 KSI (37.0)	37.0 KSI	8.0	> 37.8 KSI (SEE NOTE 4)		R 3				49.8 KSI	16.16	396.81
-11	CENTER SPAR	1	EXTRU×54 (21.6 IN²)	103.77	AL EXTRU	F_{tu} = 71.5 KSI											17.64	430.28
-13	AFT AUX SPAR	1	EXTRU×54 (20.0 IN²)	95.76	AL EXTRU	F_{tu} = 71.5 KSI											13.41	403.19
-15	REAR SPAR	1	.42×110×54	249.50	7050-T73 AL ALLOY	F_{tu} = 60.0 KSI											9.87	493.28
	ALL LOWER SURFACE SKINS (SEE TABLE I.)					F_{tu} = 70.0 KSI	F = 46.1 KSI (36.7)	36.7 KSI	1.0	37.4 KSI	75	F S		2.2 INCHES		70.0 KSI	76.04	586.10
	ADHESIVE (SEE NOTE 3)																6.63	93.15
-5	SKIN PANEL ASSY	1	-	-	-	F_{ty} = 62.5									.18/MM UT-X-RAY			
	SEE TABLE II FOR ALL DETAILS																116.49	995.40
-55	SPAR CAP	1	EXTRU×54	3.41	AL												2.17	15.68
-57	SPAR CAP	1	EXTRU×54	3.73	AL												2.45	16.58
-59	SPAR CAP	1	EXTRU×54	3.41	AL												2.17	15.68
C387V4-8	BOLT	90			TI												.65	50.40
C387V4-7	BOLT	96			TI												.64	51.68
C387V5-19	BOLT	74			TI												1.52	47.36
C387V5-20	BOLT	37			TI												.78	25.90
C520-428-3	NUT	96			STL												.55	37.44
C520-428-4	NUT	90			STL												.57	36.00
C520-524-3	NUT	74			STL												.65	36.26
C520-524-4	NUT	37			STL												.35	20.35
C556-4	INJ. FTG.	8			TI												.03	7.92
C556-3	INJ. FTG.	8			TI												.03	7.92
NAS1528-3	PIN	158			AL												.92	29.86
NAS1080D8	COLLAR	158			AL												.32	3.16
-1	ASS'Y																	287.27
																TOTAL	283.9	4,554.84

1/30/[illegible]

TABLE I.

DETAILS OF LOWER SURFACE SKINS

DASH NO.	RAW STOCK SIZE	RAW STOCK WT.	MATERIAL	FINISHED STOCK SIZE	FINISHED WT. IN LBS.
-17	.100 × 7.0 × 49	3.43	7050-T76 ALUMINUM ALLOY SHEET	.100 × 6.80 × 48	3.26
-19	.100 × 8.3 × 49	4.07		.100 × 8.11 × 48	3.89
-21	.100 × 9.6 × 49	4.70		.100 × 9.48 × 48	4.55
-23	.100 × 11.0 × 49	5.39		.100 × 10.86 × 48	5.21
-25	.100 × 12.4 × 49	6.08		.100 × 12.23 × 48	5.87
-27	.090 × 6.8 × 49	3.00		.090 × 6.69 × 48	2.89
-29	.090 × 8.2 × 49	3.62		.090 × 8.02 × 48	3.46
-31	.090 × 9.5 × 49	4.19		.090 × 9.39 × 48	4.06
-33	.090 × 10.9 × 49	4.81		.090 × 10.77 × 48	4.65
-35	.090 × 12.3 × 49	5.42		.090 × 12.14 × 48	5.24
-37	.080 × 6.4 × 49	2.51		.080 × 6.27 × 48	2.41
-39	.080 × 7.8 × 49	3.06		.080 × 7.60 × 48	2.92
-41	.080 × 9.1 × 49	3.57		.080 × 8.96 × 48	3.44
-43	.080 × 10.5 × 49	4.12		.080 × 10.34 × 48	3.91
-45	.080 × 11.9 × 49	4.66		.080 × 11.71 × 48	4.50
-47	.080 × 8.4 × 49	3.29		.080 × 8.26 × 48	3.17
-49	.080 × 9.7 × 49	3.80		.080 × 9.58 × 48	3.68
-51	.080 × 11.1 × 49	4.35		.080 × 10.94 × 48	4.20
-53	.080 × 12.5 × 49	4.90		.080 × 12.32 × 48	4.73

TOTAL 76.04

TABLE II.

-5 SKIN PANEL ASSEMBLY

DASH NO.	PART NAME	RAW STOCK SIZE	RAW STOCK WT.	MATERIAL	FINISHED STOCK SIZE	FINISHED WT. IN LBS.
-61	EDGE MEMBER	1.0 × 3.6 × 54	19.44	7050-T73 AL	-	2.25
-63	EDGE MEMBER	1.0 × 4.6 × 54	24.84		-	3.54
-65	SLUG	1.0 × 6.1 × 54	32.94		-	17.16
-67	SLUG	1.0 × 5.3 × 54	28.62		-	14.10
-69	SLUG	1.0 × 5.6 × 54	30.24	7050-T73 AL	-	15.40
-71	CORE	1.0 × 9.0 × 54		P006-1B AL CORE (FMS-1070A) 4.5 LB/FT³	.750 × 8.75 × 48	3.33
-73	CORE	1.0 × 9.2 × 54			.750 × 9.02 × 48	
-75	CORE	1.0 × 8.4 × 54			.750 × 8.21 × 48	
-77	CORE	1.0 × 9.3 × 54			.785 × 9.17 × 48	
-79	OUTER SKIN	.125 × 54 × 60	40.50	7050-T76 AL	.125 × 48.0 × 53	29.61
-81	INNER SKIN	.125 × 54 × 55	37.13	7050-T76 AL	.125 × 48.0 × 48.5	27.71
	ADHESIVE	(SEE NOTE 3)			-	3.39

TOTAL 116.49

4. VALUE ASSUMED PENDING TEST RESULTS
3. USE AF143 ADHESIVE (3M COMPANY) BETWEEN ALL LOWER SURFACE SKINS AND ADJACENT SPARS IN THE -3 ASSEMBLY, AND BETWEEN ALL EDGE MEMBERS, SLUGS, CORE AND SKINS IN THE -5 ASSEMBLY.
2. THE FAYING SURFACES AT THE FRONT AND REAR SPARS, AND ALL FASTENERS, SHALL BE SEALED PER FPS-1004.
1. INSTALL C556 INJECTION FITTINGS PER M076 EQUALLY SPACED BETWEEN FASTENERS AS SHOWN AND CENTERED ON THE SEALING GROOVE. PLUG WITH NAS 1081-06A3 SCREWS.

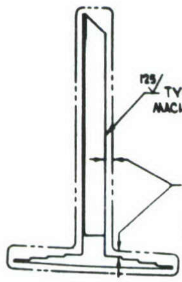
NOTES:

PRELIMINARY DESIGN DRAWING

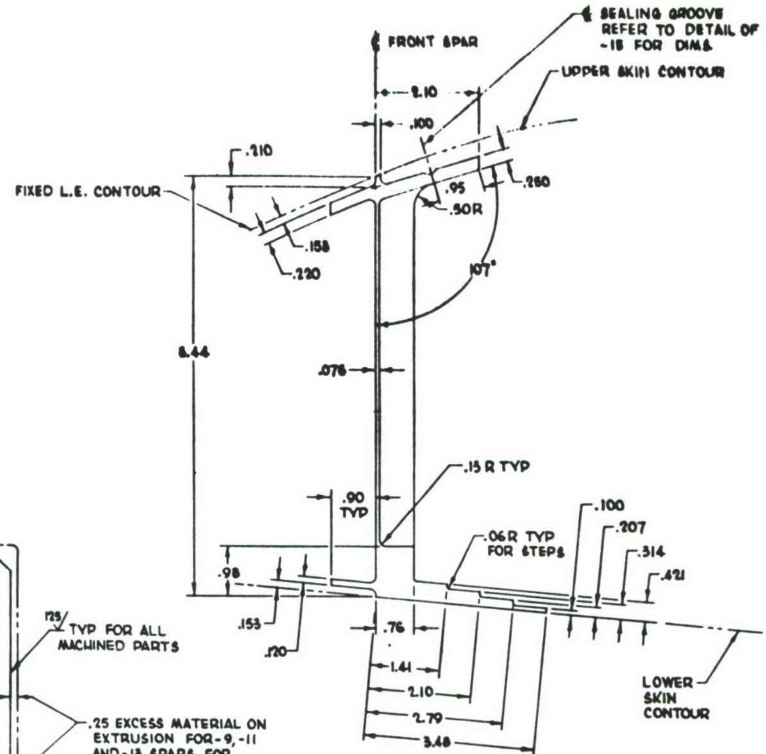
ANALYTICAL ASSY-LAMINATED LOWER AL SKIN WITH MACHINED STEPPED SPAR CAPS; BONDED H'COMB UPPER PANEL (AL); CSS 140

GENERAL DYNAMICS
Convair Aerospace Division

610RA003



HALF SIZE

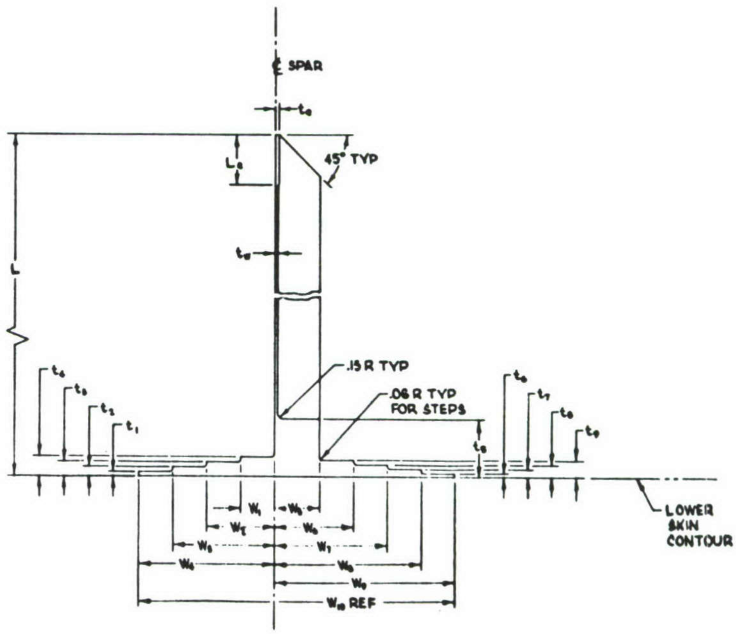


DETAIL OF -7 SPAR

FULL SIZE

DIMENSION (IN INCHES)	FWD AUX SPAR (-9)	CENTER SPAR (-11)	AFT AUX SPAR* (-13)
L	10.18	11.40	10.86
L_a	1.00	1.00	1.00
t_a	.075	.075	.075
t_w	.057	.050	.050
t_1	.100	.090	.080
t_2	.207	.187	.167
t_3	.314	.284	.254
t_4	.421	.381	DELETE*
t_5	1.27	1.15	1.04
t_6	.090	.080	.080
t_7	.187	.167	.167
t_8	.284	.254	.254
t_9	.381	.341	.341
W_1	.69	.69	DELETE*
W_2	1.38	1.38	.69
W_3	2.06	2.06	1.38
W_4	2.75	2.75	2.06
W_5	.88	.91	.90
W_6	1.57	1.60	1.59
W_7	2.25	2.29	2.28
W_8	2.94	2.97	2.96
W_9	3.64	3.66	3.65
W_{10} REF	6.38	6.41	5.71

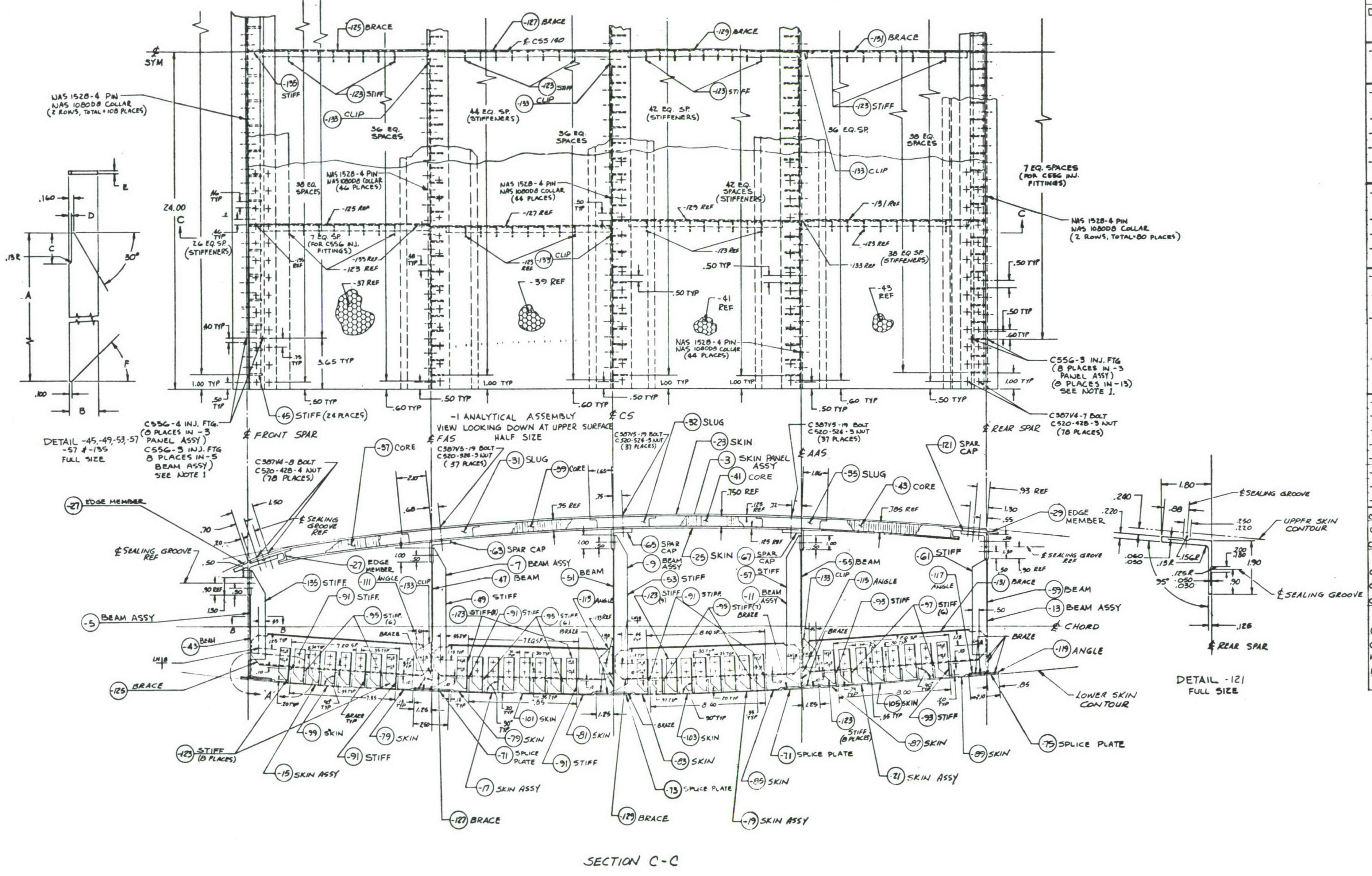
*FOR AFT AUX SPAR, ROTATE THE SPAR DETAIL SECTION 180° AND DELETE ONE STEP FROM THE AFT ELEMENT



DETAIL OF -9, -11 AND -13 SPARS

FULL SIZE

Sheet 2



-1 ANALYTICAL ASSY ~ CONCEPT DATA SUMMARY — 610RA004 A

DASH NO.	PART NAME	NO. REQ'D	RAW STOCK SIZE	RAW STOCK WEIGHT	MAT'L	MAT'L PROP'S APPLICABLE TO CRIT. STRESS	STATIC LIMIT DES STRESS (F x 1.5/1.5)	MAX. OPERATION STRESS	KT	ALLOW FATIGUE STRESS	FRACT TOUGH Kc KSI√IN	K1scc	DAM TOL CLASS	INSPECTABILITY CLASS	CRIT. CRACK LENGTH TYP	MIN NDI DETECT CRACK LENGTH - METH.	ALLOW FRACT STRESS	FINISHED WEIGHT IN LBS.	COST IN DOLLARS
-3	SKIN PANEL ASSY ADESIVE SEE NOTE 3 SEE TABLE II FOR ALL DETAILS	1				Fty = 62.5KSI	F= 44 KSI (35.0)	35.0 KSI	—	—						.100/PEN, UT	—	113.12	987.65
-5	BEAM ASSY	1														.100/PEN, UT		6.95	227.78
-7		1																6.87	282.23
-9		1																8.71	301.15
-11		1				Ftu = 178 (-71 PLATE)	F=116.5 (92.5)	92.5	3.0	732.5	80		F3		.395 SURFACE FLAW		102.5	7.82	271.83
-13	BEAM ASSY SEE TABLE III FOR ALL DETAILS	1														.100/PEN UT		6.83	286.96
-15	SKIN ASSY	1														.150/UT		18.05	342.65
-17		1																18.03	349.57
-19		1																17.27	327.80
-21	SKIN ASSY SEE TABLE IV FOR ALL DETAILS	1														.100/UT		10.56	281.56
-63	SPAR CAP SAME AS 610RA003-55	1	EXTRX54	3.41	AL											.05/PEN		2.17	12.51
-65	SPAR CAP SAME AS 610RA003-57	1	EXTRX54	3.73	AL											.05/PEN		2.45	13.11
-67	SPAR CAP SAME AS 610RA003-59	1	EXTRX54	3.41	AL													2.17	12.51
-107	ANGLE	1	.063X2.5 X49	1.35	8-8-2-3TI													1.06	20.65
-109	ANGLE	1	.063X3.2 X49	1.73	8-8-2-3TI													1.46	26.16
-111	ANGLE	1	.050X3.0 X49	1.28	8-8-2-3TI													1.05	22.13
-113	ANGLE	1	.063X3.0 X49	1.62	8-8-2-3TI													1.32	24.56
-115	ANGLE	1	.050X3.0 X49	1.28	8-8-2-3TI													1.05	22.13
-117	ANGLE	1	.050X3.0 X49	1.28	8-8-2-3TI													1.05	22.13
-119	ANGLE	1	.063X2.5 X49	1.35	8-8-2-3TI													1.05	20.65
-121	SPAR CAP	1	EXTRX54	3.24	AL													2.88	12.20
C387V4-8	BOLT	78			TI													.56	
C387V4-7	BOLT	78			TI													.49	
C387V5-19	BOLT	111			TI													2.28	
C520-428-3	NUT	78			STL													.56	
C520-428-3	NUT	78			STL													.49	(see -1)
C520-524-3	NUT	111			STL													2.28	
C556-4	INJ. FTG	8			TI													.03	
C556-3	INJ. FTG	24			TI													.09	
NAS1528-4	PIN	322			AL													.65	
NAS 1080D8	COLLAR	322			AL													.65	

(CONTINUED)

SUB TOTAL WT 240.00 —

TABLE II
-3 SKIN PANEL ASSY

DASH NO.	PART NAME	RAW STOCK SIZE	RAW STOCK WT	MATERIAL	FINISHED STOCK SIZE	FINISHED WT IN LBS
-23 SAME AS 610RA003-79	OUTER SKIN	.125 x 54 x 60	40.5	7050-T76 AL	.125 x 48.0 x 53	29.61
-25 SAME AS 610RA003-81	INNER SKIN	.125 x 54 x 55	37.13	7050-T76-AL	.125 x 48.0 x 48.5	27.71
-27 SAME AS 610RA003-61	EDGE MEMBER	1.0 x 3.6 x 54	19.44	7050-T73-AL	-	2.25
-29 SAME AS 610RA003-63	EDGE MEMBER	1.0 x 4.6 x 54	24.84	7050-T73-AL	-	3.64
-31 SAME AS 610RA003-65	SLUG	1.0 x 6.1 x 54	32.94	7050-T73-AL	—	17.16
-33 SAME AS 610RA003-67	SLUG	1.0 x 5.3 x 54	28.62	7050-T73-AL	—	14.10
-35 SAME AS 610RA003-69	SLUG	1.0 x 5.6 x 54	30.24	7050-T73-AL	—	15.40
-37 SAME AS 610RA003-71	CORE	1.0 x 9.0 x 54		P006-1B AL CORE (FMS-1070A) 4.5 LBS/FT3	.750 x 8.75 x 48	.82
-39 SAME AS 610RA003-73	CORE	1.0 x 9.2 x 54			.750 x 9.02 x 48	.86
-41 SAME AS 610RA003-75	CORE	1.0 x 8.4 x 54			.750 x 8.21 x 48	.77
-43 SAME AS 610RA003-77	CORE	1.0 x 9.3 x 54			.785 x 9.17 x 48	.90

TOTAL WT 113.12

TABLE III

BEAM ASSY NO	DASH NO	PART NAME	RAW STOCK SIZE	RAW STOCK WT	MATERIAL	FINISHED STOCK SIZE	FINISHED WT IN LBS	QUANTITY	TOTAL WT IN LBS	TOTAL WT PER ASSY
-5	-43	BEAM	.125 x 8.6 x 49	9.17	8-8-2-3TI	.125 x 7.62 x 48	3.82	1	3.82	6.73 + .22 = 6.95
	-45	STIFF	.080 x 1.37 x 7.15	.136		.080 x .87 x 6.14	.062	24	1.49	
	-69	SPLICE PLATE	.080 x 2.63 x 49	1.80		.080 x 2.13 x 48	1.42	1	1.42	
-7	-47	BEAM	.125 x 11.4 x 49	12.22		.125 x 10.36 x 48	3.02	1	3.02	6.87
	-49	STIFF.	.050 x 1.46 x 11.20	.143		.050 x .96 x 10.19	.062	45	2.10	
	-71	SPLICE PLATE	.050 x 3.0 x 49	1.28		.050 x 2.50 x 48	1.05	1	1.05	
-9	-51	BEAM	.125 x 12.3 x 49	13.20		.125 x 11.29 x 48	3.20	1	3.20	8.71
	-53	STIFF.	.050 x 1.52 x 12.13	.161		.050 x 1.02 x 11.13	.089	43	3.83	
	-73	SPLICE PLATE	.080 x 3.0 x 49	2.05		.080 x 2.50 x 48	1.68	1	1.68	
-11	-55	BEAM	.125 x 11.86 x 49	11.79		.125 x 10.86 x 43	3.12	1	3.12	7.82
	-57	STIFF	.050 x 1.52 x 11.71	.155		.050 x 1.02 x 10.71	.085	43	3.65	
	-71	SPLICE PLATE	SEE ABOVE	1.28		SEE ABOVE	1.05	1	1.05	
-13	-59	BEAM	.125 x 11.01 x 49	11.74		.125 x 10.01 x 48	3.40	1	3.40	6.83
	-61	STIFF.	.050 x 1.55 x 9.05	1.23		.050 x 1.05 x 8.05	.065	39	2.55	
	-75	SPLICE PLATE	.050 x 2.6 x 49	1.11	8-8-2-3TI	.050 x 2.10 x 48	.88	1	.88	
-5	-135	STIFF	.080 x 1.50 x 7.15	.150	8-8-2-3TI	.080 x 1.05 x 6.14	.075	3	.22	.22 (ADD TO -5)

TABLE IV

BEAM ASSY NO	DASH NO	PART NAME	RAW STOCK SIZE	RAW STOCK WT	MATERIAL	FINISHED STOCK SIZE	FINISHED WT IN LBS	QUANTITY	TOTAL WT IN LBS	TOTAL WT PER ASSY
-15	-77	SKIN	.250 x 3.20 x 49	6.86	8-8-2-3TI	.170 x 2.68 x 48	2.11	1	2.11	18.05
	-79	SKIN	.140 x 2.83 x 49	3.40	8-8-2-3TI	.140 x 2.33 x 48	1.82	1	1.82	
	-91	STIFF	.125 x 1.62 x 49	1.71	8-8-2-3TI	.125 x 1.12 x 48	1.176	2	2.35	
	-95	STIFF	.125 x 1.5 x 49	1.60	8-8-2-3TI	.125 x .97 x 48	1.01	6	6.06	
	-99	SKIN	.090 x 8.0 x 49	6.17	8-8-2-3TI	.090 x 7.55 x 48	5.71	1	5.71	
-17	-79	SKIN	←		SEE ABOVE	→	1.82	1	1.82	18.03
	-81	SKIN	.190 x 2.83 x 49	4.60	8-8-2-3TI	.170 x 2.33 x 48	1.84	1	1.84	
	-91	STIFF	←		SEE ABOVE	→	1.176	2	2.35	
	-95	STIFF	←		SEE ABOVE	→	1.01	6	6.06	
	-101	SKIN	.090 x 8.30 x 49	6.34	8-8-2-3TI	.090 x 7.85 x 48	5.96	1	5.96	
-19	-83	SKIN	.160 x 2.83 x 49	3.87	8-8-2-3TI	.151 x 2.33 x 48	1.44	1	1.44	17.27
	-85	SKIN	.125 x 2.83 x 49	3.00	8-8-2-3TI	.121 x 2.33 x 48	1.42	1	1.42	
	-91	STIFF	←		SEE ABOVE	→	1.17	2	2.34	
	-95	STIFF	←		SEE ABOVE	→	1.01	7	7.07	
	-103	SKIN	.071 x 8.90 x 49	5.41	8-8-2-3TI	.071 x 8.40 x 48	5.00	1	5.00	
-21	-87	SKIN	.100 x 2.83 x 49	2.42	8-8-2-3TI	.100 x 2.33 x 48	1.03	1	1.03	10.56
	-89	SKIN	.125 x 2.93 x 49	3.13	8-8-2-3TI	.120 x 2.43 x 48	1.09	1	1.09	
	-93	STIFF	.100 x 1.34 x 49	1.15	8-8-2-3TI	.100 x .84 x 48	.71	2	1.42	
	-97	STIFF	.100 x 1.25 x 49	1.07	8-8-2-3TI	.100 x .73 x 48	.61	6	3.66	
	-105	SKIN	.050 x 8.50 x 49	3.64	8-8-2-3TI	.050 x 8.00 x 48	3.36	1	3.36	

4. VALUE ASSUMED PENDING TEST RESULTS
3. USE AF 143 ADHESIVE (3M COMPANY) BETWEEN ALL EDGE MEMBERS, SLUGS, CORE, AND SKINS IN THE -3 ASSEMBLY.
2. THE FAYING SURFACES AT THE FRONT & REAR SPARS, AND ALL FASTENERS SHALL BE SEALED PER FPS-1004.
1. INSTALL C556 INJECTION FITTINGS PER M076 EQUALLY SPACED BETWEEN FASTENERS AS SHOWN AND CENTERED ON THE SEALING GROOVE. PLUG WITH NAS 1081-06A3 SCREWS.

NOTES:

PRELIMINARY DESIGN DRAWING

ANALYTICAL ASSY- AL HONEYCOMB SANDWICH UPPER PANEL - TI BLADE STIFFENED PLANK LOWER - CSS 140.00

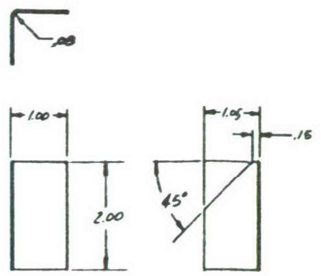
BY H.B. STANLEY

GENERAL DYNAMICS
Convair Aerospace Division

610RA004A

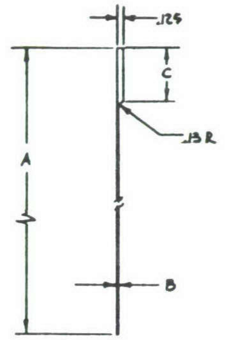
(CONTINUED)

-1 ANALYTICAL ASSEMBLY - CONCEPT DATA SUMMARY																			610RA004A
DASH NO.	PART NAME	NO. REQ'D	RAW STOCK SIZE	RAW STOCK WT.	MATL	MATL PROPS APPLICABLE TO CRITICAL STRESS	STATIC LIMIT DES. STRESS (F_x 15 S/AS)	MAX OPERATING STRESS	K_T	ALLOW. FATIGUE STRESS	FRACT. TOUGH	K_{ISCC}	DAM TOL. CLASS	INSPECTABILITY CLASS	CRIT CRACK LENGTH TYPE	MIN. NDI DETECT. CRACK LENGTH METH.	ALLOW. FRACT. STRESS	FINISHED WEIGHT IN LBS.	COST IN DOLLARS
-123	STIFF	99	.050 x 2.9 x 2.7	6.37	8-8-2-STI													2.77	110.99
-125	BRACE	3	1.25 x 2.50 x 13.8	7.8463 = 22.62	8-8-2-STI													1.086	266.53
-127	BRACE	3	1.25 x 2.50 x 13.9	7.6 x 3 = 22.80	8-8-2-STI													1.095	267.67
-129	BRACE	3	1.25 x 2.50 x 14.4	7.87 x 3 = 23.61	8-8-2-STI													1.137	272.76
-131	BRACE	3	1.25 x 2.50 x 14.0	7.65 x 3 = 22.95	8-8-2-STI													1.089	268.61
-133	CLIP	9	.050 x 2.00 x 2.5															.298	94.76
	MS20615-4M	198																1.668	
	MS20615-8M	24																.804	
-1	ANALYTICAL ASSY																		3376.11
																	SUB TOTAL	9.937	
																	SUB TOTAL	240.00	
																	TOTAL	249.937	9576.07

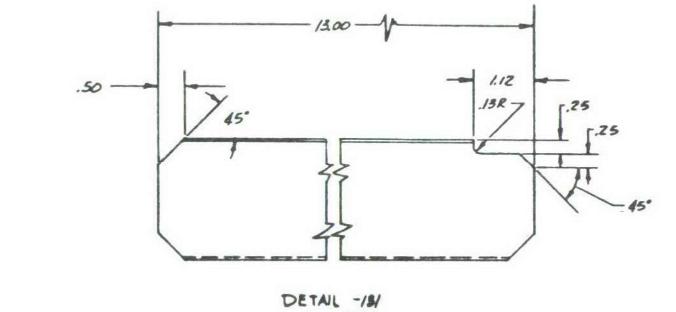


DETAIL -133
FULL SIZE

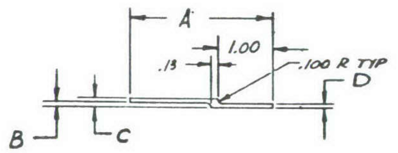
DASH NO	DIMENSION A	B	C	D	E	F
-43	7.63	.040	1.80			
-45	6.14	.87	1.95	.085	.080	45°
-47	10.36	.025	1.00			
-49	0.19	.96	1.15	.100	.050	45°
-51	1.29	.025	1.00			
-53	1.13	1.02	1.15	.100	.050	45°
-55	0.86	.025	1.00			
-57	10.71	1.02	1.15	.100	.050	45°
-59	10.01	.025	1.80			
-135	7.63	1.05	1.80	.085	.080	—



DETAIL -43, -47, -51, -55, -59
FULL SIZE

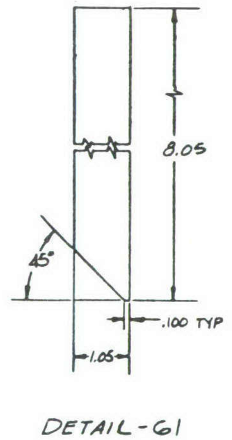


DETAIL -131
FULL SIZE
SAME AS -125 EXCEPT AS SHOWN

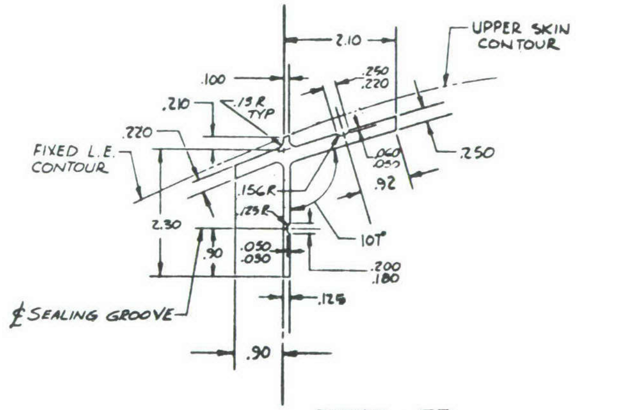


DETAIL -77, -79, -81,
-83, -85, -87, & -89

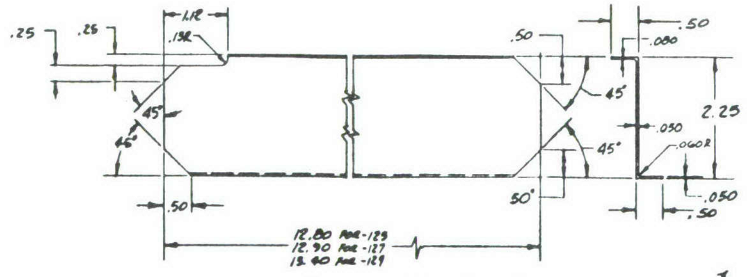
DASH NO.	DIMENSION A	B	C	D
-77	2.68	.080	.170	.090
-79	2.33	.050	.140	.090
-81	2.33	.080	.170	.090
-83	2.33	.080	.151	.071
-85	2.33	.050	.121	.071
-87	2.33	.050	.100	.050
-89	2.93	.071	.121	.050



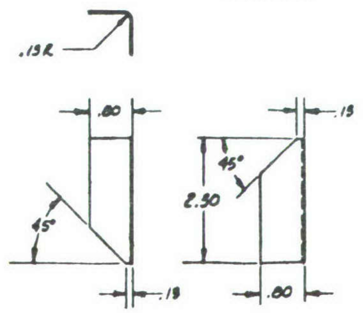
DETAIL -61



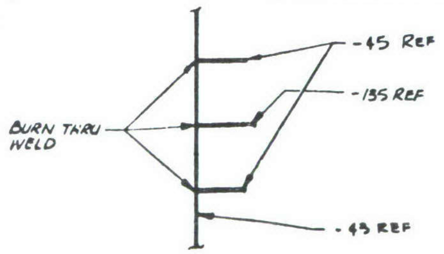
DETAIL -27
FULL SIZE



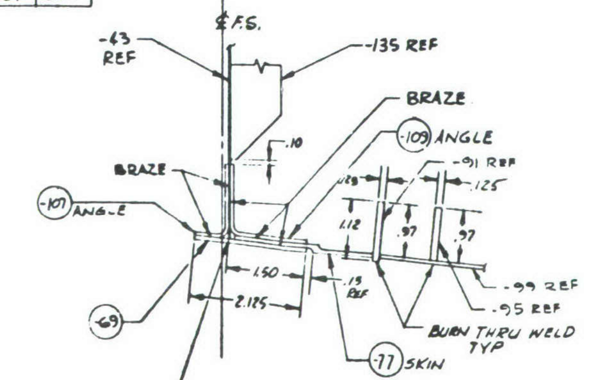
DETAIL -125, -127, -129
FULL SIZE



DETAIL -123
FULL SIZE



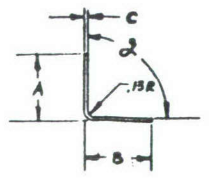
SECTION B-B (TYPICAL)
TYP AT ℄ FAS, ℄ CS,
℄ RAS & ℄ RS



BURN THRU WELD
TYP AT FAS, CS, RAS,
& RS

DETAIL 'A'
FULL SIZE
TYPICAL EXCEPT AS SHOWN
-123 & -125 OMITTED FOR CLARITY

DASH NO	DIMENSION A	B	C	α
-107	1.40	.625	.063	84°
-109	1.31	1.46	.063	96°
-111	1.25	1.25	.050	87°46'
-113	1.25	1.25	.063	90°
-115	1.25	1.25	.050	86°30'
-117	1.25	1.25	.050	95°
-119	1.25	.83	.060	85°



DETAIL -107, -109, -111,
-113, -115, -117, & -119

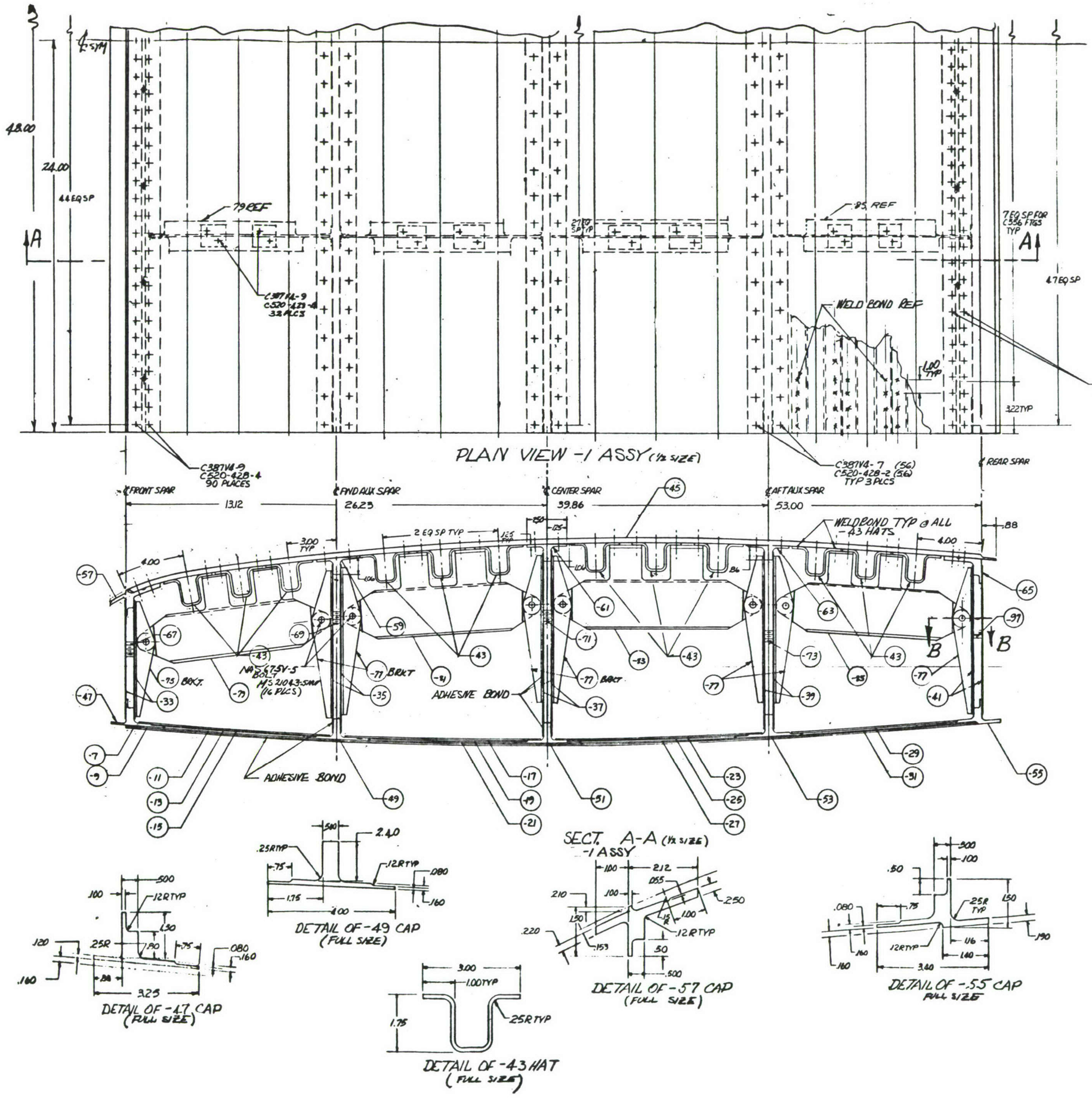


TABLE I - -3 UPPER SKIN ASSY PARTS

DASH NO.	NAME	NO REQD	RAW STOCK SIZE	RAW STK. WT.	MATL.	FINISHED PART SIZE	FIN. WT. LBS
-45	UPR. SKIN	1	.30 x 54 x 60	103.44	7050	.30 x 53 x 48	74.56
-43	HATS	12	.125 x 3.50 x 50	91.25	7050	.125 x 3.50 x 48	39.60
✓	ADHES.	–		.833	AF143		.90
						TOT	119.26

-5 LOWER SKIN ASSY PART

DASH NO.	NAME	NO REQD	RAW STOCK SIZE	RAW STK. WT.	MATL.	FINISHED PART SIZE	FIN. WT. LBS
-7	SKIN	1	.10 x 54 x 60	32.4	7050	.10 x 53 x 48	25.44
-9		1	.10 x 54 x 60	32.4		.10 x 53 x 48	25.44
-11		1	.080 x 7.9 x 50	3.52		.080 x 8.8 x 48	3.38
-13		1	.080 x 10.7 x 50	4.08		.080 x 10.2 x 48	3.92
-15		1	.120 x 12.0 x 50	7.20		.120 x 12 x 48	6.92
-17		1	.10 x 12.2 x 50	6.10		.10 x 12.2 x 48	5.86
-19		1	.080 x 10.4 x 50	4.16		.08 x 10.4 x 48	4.00
-21		1	.080 x 9.0 x 50	3.60		.08 x 9.0 x 48	3.46
-23		1	.080 x 12.7 x 50	5.08		.08 x 12.7 x 48	4.88
-25		1	.080 x 11.1 x 50	4.44		.08 x 11.1 x 48	4.26
-27		1	.080 x 9.6 x 50	3.84		.080 x 9.6 x 48	3.68
-29		1	.080 x 10.2 x 50	4.08		.080 x 10.2 x 48	3.92
-31	SKIN	1	.080 x 8.9 x 50	3.56	7050	.080 x 8.9 x 48	3.42
✓	ADHESIVE	–		7.5	AF143		7.08
							105.66

-87 FRONT SPAR ASSY PARTS

DASH NO.	NAME	NO REQD	RAW STOCK SIZE	RAW STK. WT.	MATL.	FINISHED PART SIZE	FIN. WT. LBS
-33	SKIN	2	.020 x 7.3 x 50	1.46	7050	.020 x 7.3 x 48	1.40
-47	CAP	1	EXTR x .75 in² x 50	8.75		EXTR x .65 in² x 48	3.121
-57	CAP	1	EXTR x 1.9 in² x 50	9.2	7050	EXTR x .93 in² x 48	5.435
-67	CORE	1	.50 x 6.2 x 50	.404	4.5 # AL	.50 x 6.2 x 48	.376
-75	BRKT	2	EXTR x .18 in² x 9.5	.27	7050	EXTR x .094 in² x 9.0	.187
✓	ADHESIVE	✓	.007	.755	AF143	—	.725
							11.30

-89 FRONT AUX SPAR ASSY PARTS

DASH NO.	NAME	NO REQD	RAW STOCK SIZE	RAW STK. WT.	MATL.	FINISHED PART SIZE	FIN. WT. LBS
-35	SKIN	2	.016 x 10.4 x 50	1.66	7050	.016 x 10.4 x 48	1.600
-69	CORE	1	.50 x 8.9 x 50	.58	4.5 #/ft³ AL	.50 x 8.9 x 48	.555
-49	CAP	1	EXTR x .75 in² x 50	8.75	7050	EXTR x 1.15 in² x 48	5.505
-59	CAP	1	EXTR x .91 in² x 50	4.56	7050	EXTR x .81 in² x 48	3.873
-77	BRKT	4	EXTR x .18 in² x 9.5	.624	7050	EXTR .094 in² x 9.5	.477
✓	ADHESIVE	✓	.007	1.43	AF143	—	1.37
							13.38

-91 CENTER SPAR ASSY PARTS

DASH NO.	NAME	NO REQD	RAW STOCK SIZE	RAW STK. WT.	MATL.	FINISHED PART SIZE	FIN. WT. LBS
-37	SKIN	2	.016 x 11.4 x 50	1.823	7050	.016 x 11.4 x 48	1.75
-71	CORE	1	.50 x 9.9 x 50	.645	4.5 #/ft³ AL	.50 x 9.9 x 48	.62
-51	CAP	1	EXTR x .75 in² x 50	3.75	7050	EXTR x 1.15 in² x 48	5.505
-61	CAP	1	EXTR x .91 in² x 50	4.56	7050	EXTR x .81 in² x 48	3.873
-77	BRKT	4	EXTR x .18 in² x 9.5	.624	7050	EXTR x .094 in² x 9.0	.477
✓	ADHESIVE	✓	.007	1.58	AF143	—	1.52
						TOT.	13.74

-93 AFT AUX SPAR ASSY PARTS

DASH NO.	NAME	NO REQD	RAW STOCK SIZE	RAW STK. WT.	MATL.	FINISHED PART SIZE	FIN. WT. LBS
-39	SKIN	2	.016 x 10.1 x 50	1.615	7050	.016 x 10.1 x 48	1.55
-73	CORE	1	.50 x 9.5 x 50	.63	4.5 #/ft³ AL	.50 x 9.5 x 48	.594
-53	CAP	1	EXTR x 1.75 in² x 50	8.75	7050	EXTR x 1.15 in² x 48	5.505
-63	CAP	1	EXTR x .91 in² x 50	4.56	7050	EXTR x .80 in² x 48	3.873
-77	BRKT	4	EXTR x .18 in² x 9.5	.624	7050	EXTR x .094 in² x 9.0	.477
✓	ADHESIVE	✓	(.007)	1.52	AF143	—	1.45
							13.44

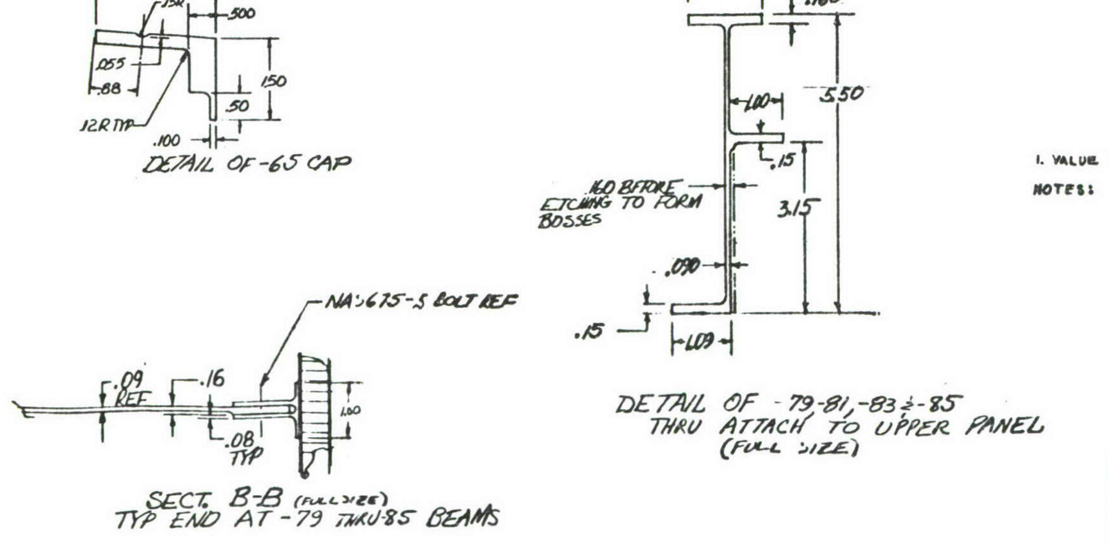
-95 REAR SPAR ASSY PARTS

DASH NO.	NAME	NO REQD	RAW STOCK SIZE	RAW STK. WT.	MATL.	FINISHED PART SIZE	FIN. WT. LBS
-41	SKIN	2	.020 x 9.1 x 50	1.82	7050	.020 x 9.1 x 50	1.75
-97	CORE	1	.50 x 8.2 x 50	.535	4.5 #/ft³ AL	.50 x 8.2 x 48	.513
-55	CAP	1	EXTR x 2.35 in² x 50	11.72	7050	EXTR x .93 in² x 48	9.454
-65	CAP	1	EXTR x 2.92 in² x 50	14.69	7050	EXTR x 1.13 in² x 48	5.432
-77	BRKT	2	EXTR x .150 in² x 9.5	.342	7050	EXTR .094 in² x 9.0	.238
✓	ADHES.	✓	(.007)	.95	AF143	—	.91
							13.29

ANALYTICAL ASSY — CONCEPT DATA SUMMARY

610KA005

DASH NO.	PART NAME	NO. REQD	RAW STOCK SIZE	RAW STOCK WEIGHT	MATL	MATL PROP APPLICABLE TO CRIT. STRESS	STATIC LIMIT DES STRESS (F x 1/1.5)	MAX OPERATING STRESS	K_T	ALLOW. FATIGUE STRESS	FRACT. TOUGH. K_{IC} KSI√IN	K_{ISCC}	DAM. TOL CLASS.	INSPECT-ABILITY CLASS.	CRIT CRACK LENGTH / TYPE	MIN. DETECT. CRACK LENGTH / METH.	ALLOW. FRACT STRESS	FINAL WT IN LBS	COST IN DOLLARS
-3	UPPER SKIN ASSY	1	SEE TABLE I			F_{cy} = 62.5 KSI	F = 41.0 KSI (32.4)	32.4 KSI	—	—						.09/UT, PEN	—	119.26	191.86
-5	LOWER SKIN ASSY	1				F_{tu} = 70.0	F = 46.7 (37.0)	37.0 KSI	1.0	>37.4 KSI SEE NOTE 1	75				.223	.15/UT PEN, X-RAY	70.0 KSI	105.66	183.56
-87	FRONT SPAR ASSY	1																11.30	118.61
-89	FRNT. AUX SPAR ASSY	1				F_{tu} = 71.5	F = 47.4 (37.5)	37.5 KSI	2.0	>37.5 KSI SEE NOTE 1							43.2 KSI	13.38	106.00
-91	CENTER SPAR ASSY	1																13.74	107.81
-93	AFT AUX SPAR	1																13.44	106.55
-95	REAR SPAR ASSY	1														.150/UT PEN, X-RAY		13.29	139.57
-79	BEAM	2	EXTR x .949 in² x 12.5	2.37	7475													1.31	12.55
-81	BEAM	2	EXTR x .949 in² x 12.5	2.37	7475													1.31	12.55
-83	BEAM	2	EXTR x .949 in² x 12.5	2.37	7475													1.31	12.55
-85	BEAM	2	EXTR x .949 in² x 12.5	2.37	7475													1.30	12.55
-1 ASSY	C387V4-7	386	BOLT															2.57	127.38
	C520-428-2	386	NUT															2.19	154.40
	NAS675V-5	16	BOLT															.12	2.76
	MS21043-5	16	NUT															.10	2.88
	SEALANT	✓																.60	
	ASSY COSTS																		1725.18
	TOTALS																	300.88	3018.58



NOTES:

1. VALUE ASSUMED PENDING TEST RESULTS

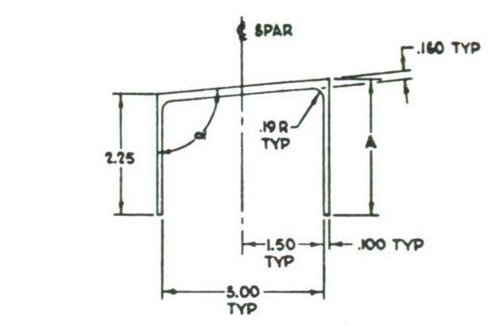
PRELIMINARY DESIGN DRAWING

ANALYTICAL ASSY ~ ADH. BONDED LAMINATED LWR. SKIN-HAT STIFF. UPPER SKIN (AL) (CSS 140.0)

GENERAL DYNAMICS
Convair Aerospace Division

610KA005

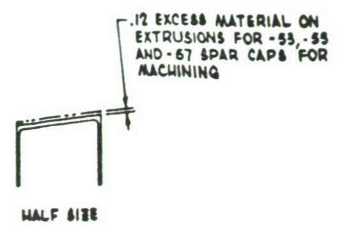
DASH NO.	A	$\alpha°$
-53	2.56	95
-55	2.40	91.5
-57	2.42	92



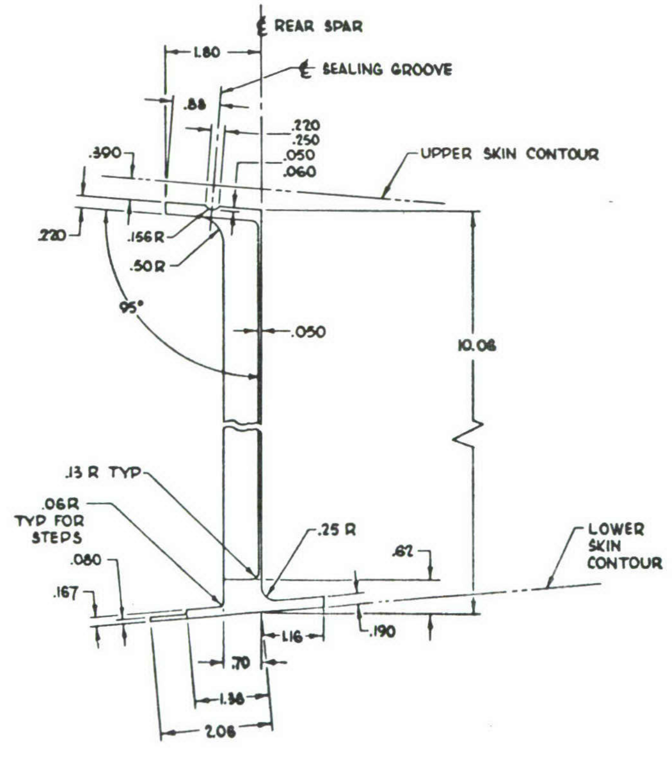
DETAIL OF -53, -55 AND -57 SPAR CAPS

(-57 ROTATED 180°)

FULL SIZE



HALF SIZE



DETAIL OF -15 SPAR

FULL SIZE

TABLE II.

-801 LOWER SURFACE ASSY

DASH NO.	PART NAME	NO. REQD.	RAW STOCK SIZE	RAW STOCK WT.	MATERIAL	FINISHED STOCK SIZE	FINISHED WT. IN LBS.
-7	FRONT SPAR	1	4.7×9.3×54	233.52	7050-T73651 AL ALLOY	-	15.79
-9	FWD. AUX. SPAR CAP	1	EXTRU×54 (12.50 IN²)	67.52	7050-T76511 AL. ALLOY	-	21.46
-11	CENTER SPAR CAP	1	EXTRU×54 (11.32 IN²)	61.12	↓	-	18.54
-13	AFT AUX. SPAR CAP	1	EXTRU×54 (10.20 IN²)	55.06	7050-T76511 AL ALLOY	-	14.91
-15	REAR SPAR	1	3.5×10.9×54	206.01	7050-T73651 AL ALLOY	-	10.75
-	ALL LOWER SURFACE SKINS (SEE TABLE I.)						54.55
-	ADHESIVE	-	63.25 FT²	(SEE NOTE 3)			6.33

TOTAL 142.33

TABLE I

DETAILS OF LOWER SURFACE SKINS

DASH NO.	RAW STOCK SIZE	RAW STOCK WT.	MATERIAL	FINISHED STOCK SIZE	FINISHED WT. IN LBS.
-17	.090×5.7×48.5	2.49	7050-T76 ALUMINUM ALLOY SHEET	.090×5.13×48.0	2.22
-19	.080×7.0×	2.72		.080×6.51×	2.50
-21	.080×8.4×	3.26		.080×7.89×	3.03
-23	.080×9.8×	3.80		.080×9.27×	3.55
-25	.080×11.2×	4.35		.080×10.65×	4.09
-27	.090×4.8×	2.10		.090×4.26×	1.84
-29	.080×6.2×	2.41		.080×5.64×	2.17
-31	.080×7.5×	2.91		.080×7.02×	2.70
-33	.080×8.9×	3.45		.080×8.40×	3.23
-35	.080×10.3×	4.00		.080×9.78×	3.76
-37	.090×5.3×	2.31		.090×4.78×	2.06
-39	.080×6.7×	2.60		.080×6.16×	2.37
-41	.080×8.1×	3.14		.080×7.54×	2.90
-43	.080×9.4×	3.65		.080×8.92×	3.43
-45	.080×10.8×	4.19		.080×10.30×	3.96
-47	.080×8.4×	3.26		.080×7.94×	3.05
-49	.080×9.8×	3.80		.080×9.32×	3.58
-51	.080×11.2×48.5	4.35	↓	.080×10.70×48.0	4.11

TOTAL 54.55

-1 ANALYTICAL ASSEMBLY - CONCEPT DATA SUMMARY

610RA006

DASH NO.	PART NAME	NO. REQD.	RAW STOCK SIZE	RAW STOCK WT.	MATL.	MATL PROPS. APPLICABLE TO CRITICAL STRESS	STATIC LIMIT DES STRESS (F_{x} 1.5/1.5)	MAX. OPERATING STRESS	K_T	ALLOW. FATIGUE STRESS	FRACT. TOUGH. K_{IC}	K_{ISCC}	DAM TOL CLASS	INSPECTABILITY CLASS	CRIT CRACK LENGTH TYPE	MIN NDI DETECT CRACK LENGTH METH	ALLOW FRACT. STRESS	FINISHED WEIGHT IN LBS.	COST IN DOLLARS
-3	SPAR-SKIN ASSY	1	•	•	•	F_{tu}=70.0 KSI	F=46 KSI (37.1)	37.1 KSI	1.0	37.3 KSI	78		F.S	DEPOT	.335 [illegible]	.130/UT X-RAY	78 KSI		
-801	LWR. SURF. ASSY	1	(SEE TABLE II.)			F_{tu}=70 OKSI (73.7KSI)	F=40.3 (32.0)	32.0 KSI	1.8	38.6 KSI			R.S	DEPOT			49 KSI	142.33	1798.81
-803	FWD. AUX. SPAR ASSY	1	(SEE TABLE III.)			F_{tu}=70.0	F=46.7 (37.1)	37.1 KSI	1.5	38.6 KSI							49 KSI	8.91	46.28
-805	CENTER SPAR ASSY	1	(SEE TABLE IV.)			F_{tu}=70.0	F=46.8 (36.8)	36.8 KSI	1.5	38.6 KSI							49 KSI	9.49	47.42
-807	AFT AUX. SPAR ASSY	1	(SEE TABLE V.)			F_{tu}=70.0	F=41.1 (32.7)	32.7 KSI	1.5	38.6 KSI							49 KSI	8.79	46.77
-	ADHESIVE	-	1.2 FT²	(SEE NOTE 1)														.12	
-65	UPPER SKIN	1	.625×54×60	202.5	7050-T7651	F_{tu}=53.0	F=33.3 (31.2)	31.2 KSI	—	—						.05/[illegible]	—	122.82	369.00
C387V4-9	BOLT	96			TI													.36	42.24
C387V4-14	BOLT	90			TI													.91	47.70
C387V5-10	BOLT	42			TI													.59	21.84
C387V5-12	BOLT	25			TI													.39	16.50
C520-428-[illegible]	NUT	186			STL													1.17	74.40
C520-524-[illegible]	NUT	67			STL													.59	32.83
C556-6	INJ. FTG.	8			TI													.04	6.16
C556-10	INJ. FTG.	8			TI													.05	9.84
-1	ASSY																		784.95
																	TOTAL	296.94	3348.74

TABLE III.

-803 SPAR ASSY (FWD. AUX. SPAR)

DASH NO.	PART NAME	NO. REQD.	RAW STOCK SIZE	RAW STOCK WT.	MATERIAL	FINISHED STOCK SIZE	FINISHED WT. IN LBS.
-53	FWD. AUX. SPAR CAP	1	EXTRU×54 (1.35 IN²)	7.26	7050-T76511 AL. ALLOY	-	4.68
-59	SPAR WEB	1	.071×10×68.5	4.86	7050-T76	.071×9.45×62.4	4.19
-	ADHESIVE	-	.4 FT²	(SEE NOTE 1)		-	.04

TOTAL 8.91

TABLE IV.

-805 SPAR ASSY (CENTER SPAR)

DASH NO.	PART NAME	NO. REQD.	RAW STOCK SIZE	RAW STOCK WT.	MATERIAL	FINISHED STOCK SIZE	FINISHED WT. IN LBS.
-55	CENTER SPAR CAP	1	EXTRU×54 (1.32 IN²)	7.18	7050-T76511 AL. ALLOY	-	4.61
-61	SPAR WEB	1	.071×11×68.5	5.35	7050-T76	.071×10.93×62.4	4.84
-	ADHESIVE	-	.4 FT²	(SEE NOTE 1)		-	.04

TOTAL 9.49

TABLE V.

-807 SPAR ASSY (AFT AUX. SPAR)

DASH NO.	PART NAME	NO. REQD.	RAW STOCK SIZE	RAW STOCK WT.	MATERIAL	FINISHED STOCK SIZE	FINISHED WT. IN LBS.
-57	AFT AUX. SPAR CAP	1	EXTRU×54 (1.33 IN²)	7.19	7050-T76511 AL. ALLOY	-	4.62
-63	SPAR WEB	1	.063×11×68.5	4.75	7050-T76	.063×10.51×62.4	4.13
-	ADHESIVE	-	.4 FT²	(SEE NOTE 1)		-	.04

TOTAL 8.79

4. THE FAYING SURFACES AT THE FRONT AND REAR SPARS, AND ALL FASTENERS, SHALL BE SEALED PER FPS-1004.
3. APPLY AF 143 ADHESIVE (3M COMPANY) BETWEEN ALL LOWER SURFACE SKINS, THE ADJACENT FRONT AND REAR SPARS, AND THE ADJACENT LOWER SPAR CAPS, ALL IN THE -801 LOWER SURFACE ASSY.
2. INSTALL C556 INJECTION FITTINGS PER MO76 EQUALLY SPACED BETWEEN FASTENERS AS SHOWN AND CENTERED ON THE SEALING GROOVE. PLUG WITH NAS 1081-06A3 SCREWS.
1. THE CORRUGATED SPAR WEBS (-59, -61 AND -63) ARE JOINED TO THE UPPER AND LOWER SPAR CAPS BY THE "WELD BOND" PROCESS WHICH COMBINES SPOTWELDING AND ADHESIVE BONDING. IN THIS PROCESS, APPLY AF 66 ADHESIVE (3M COMPANY) IN THE FAYING SURFACES OF THE PARTS BEFORE SPOTWELDING. (DESIGN AND PROCESS CONTINGENT UPON TEST.)

NOTES:

PRELIMINARY DESIGN DRAWING

ANALYTICAL ASSY - LAMINATED LWR. SKIN WITH STEPPED SPAR CAPS; PLATE UPR. SKIN; CORR. SPAR WEBS; ALUMINUM; CSS 140

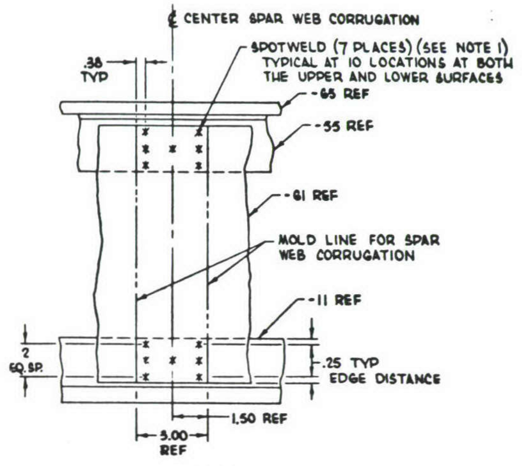
SCALE ½ NOTED DATE 1-30-75

GENERAL DYNAMICS
Convair Aerospace Division
Fort Worth Operation

610RA006

SHEET 1 OF 1

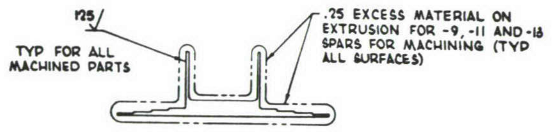
Sheet 1



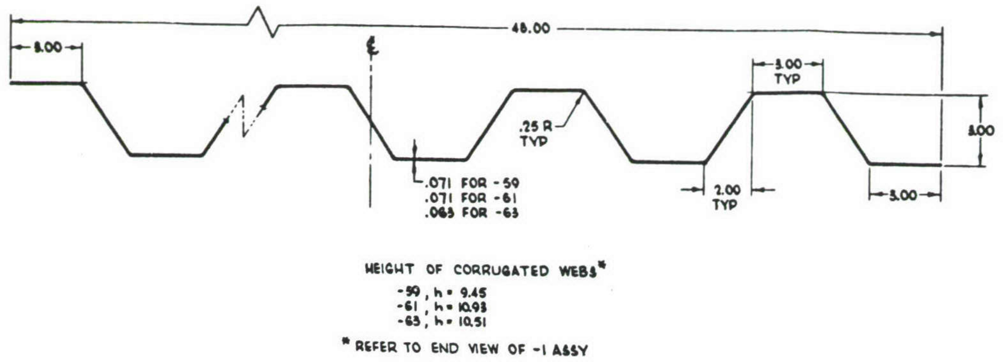
SECTION A-A

SPOTWELD PATTERN SHOWN IS TYPICAL AT THE FWD AUX AND AFT AUX SPARS

HALF SIZE



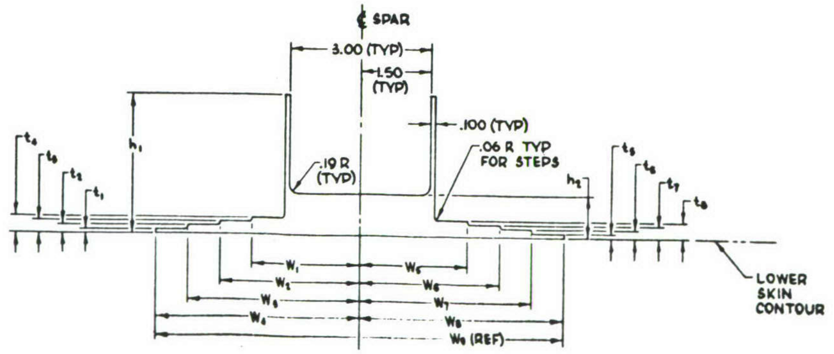
HALF SIZE



DETAIL OF -59, -61 AND -63 CORR. WEBS

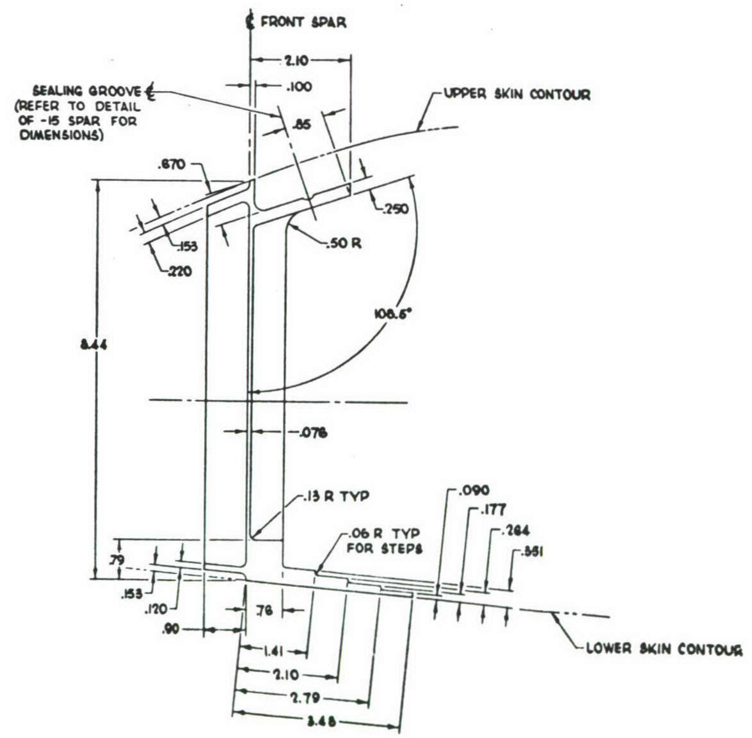
FULL SIZE

DIMENSION (IN INCHES)	FWD AUX SPAR (-9)	CENTER SPAR (-11)	AFT AUX SPAR (-13)
h_1	2.97	2.78	2.68
h_2	.88	.69	.59
t_1	.090	.090	.090
t_2	.177	.177	.177
t_3	.264	.264	.264
t_4	.351	.351	.351
t_5	.090	.090	.080
t_6	.177	.177	.167
t_7	.264	.264	DELETE
t_8	.351	.351	DELETE
W_1	2.29	2.29	2.29
W_2	2.98	2.98	2.98
W_3	3.67	3.67	3.67
W_4	4.36	4.36	4.36
W_5	2.29	2.29	DELETE
W_6	2.98	2.98	DELETE
W_7	3.67	3.67	2.29
W_8	4.36	4.36	2.98
W_9 REF	8.72	8.72	7.34



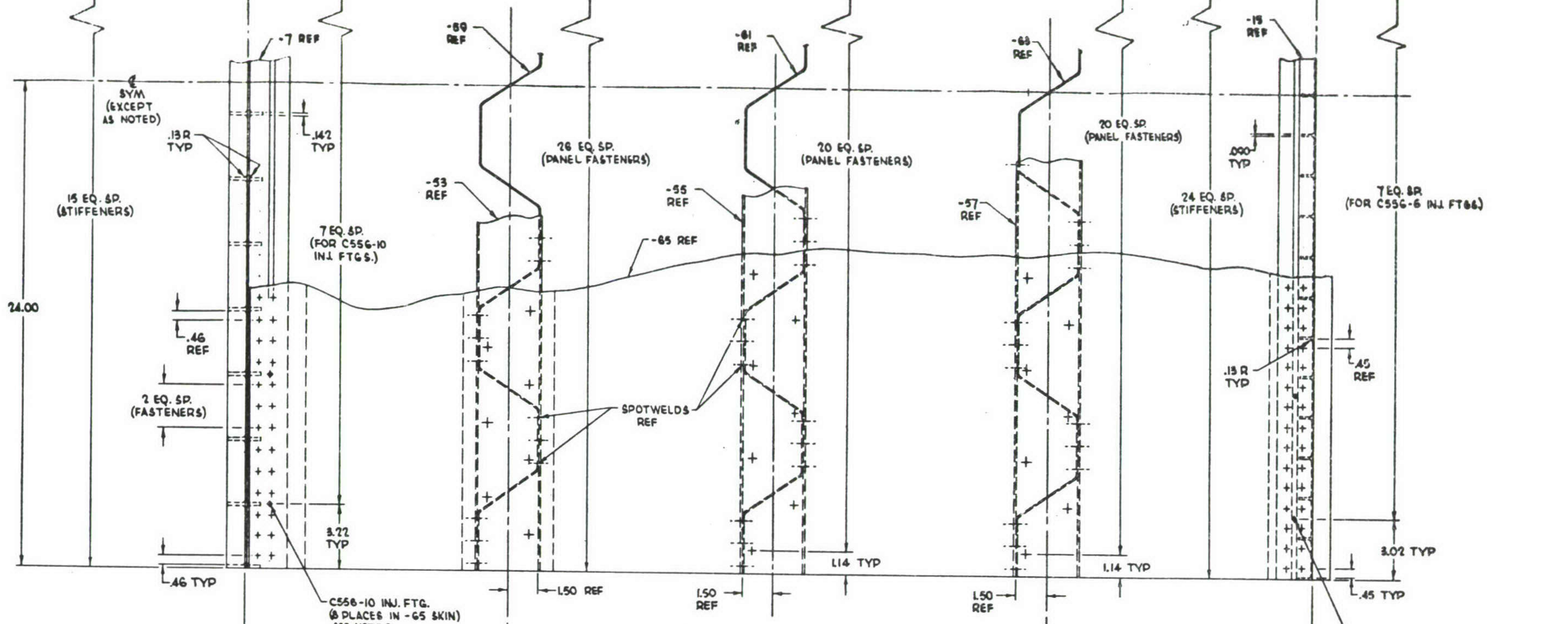
DETAIL OF -9, -11 AND -13 SPAR CAPS

FULL SIZE

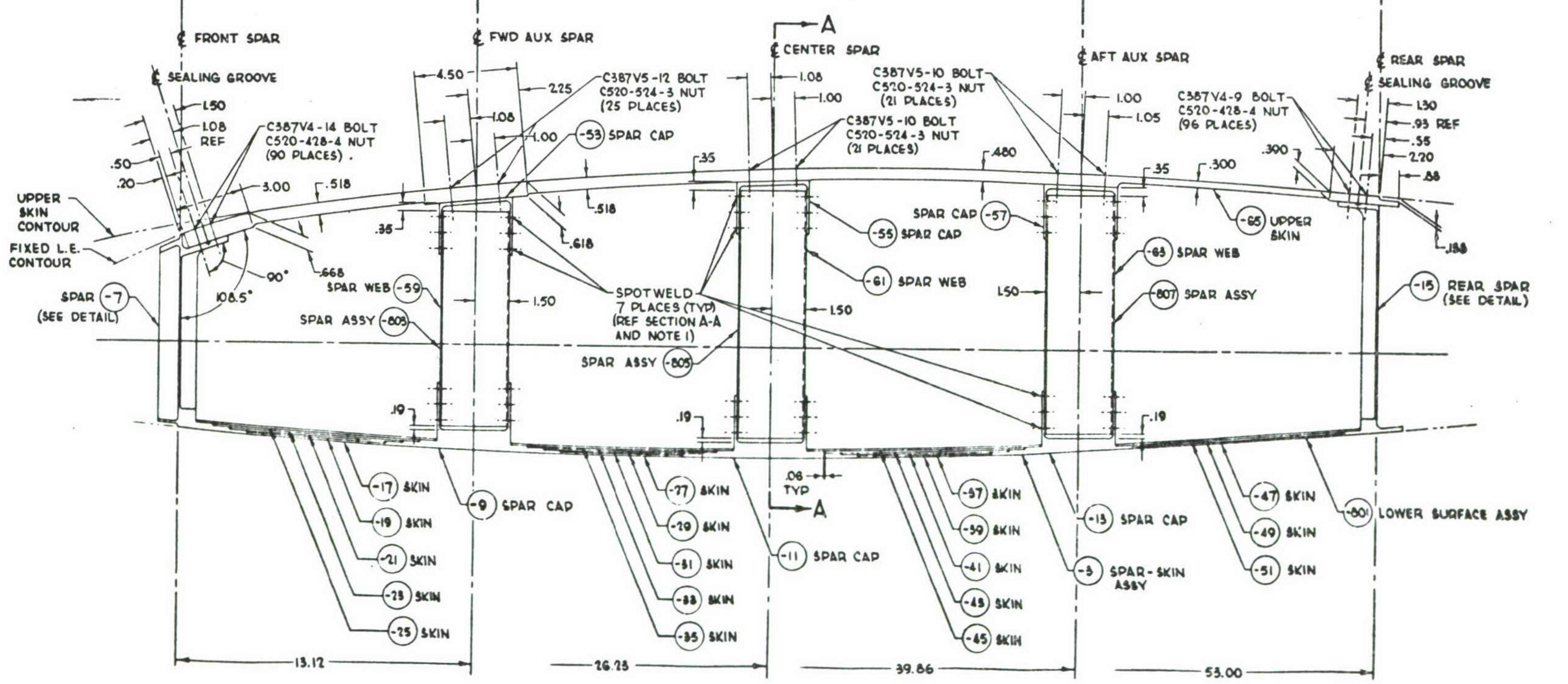


DETAIL OF -7 SPAR

FULL SIZE



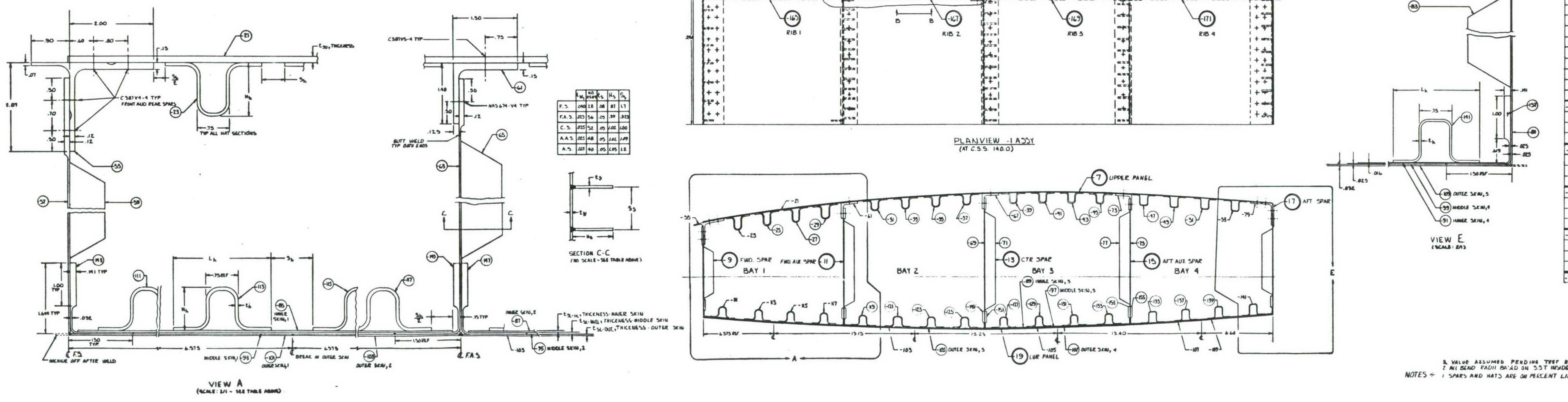
-1 ANALYTICAL ASSEMBLY
VIEW LOOKING DOWN AT UPPER SURFACE
HALF SIZE
(CENTER SPAR STA 140)

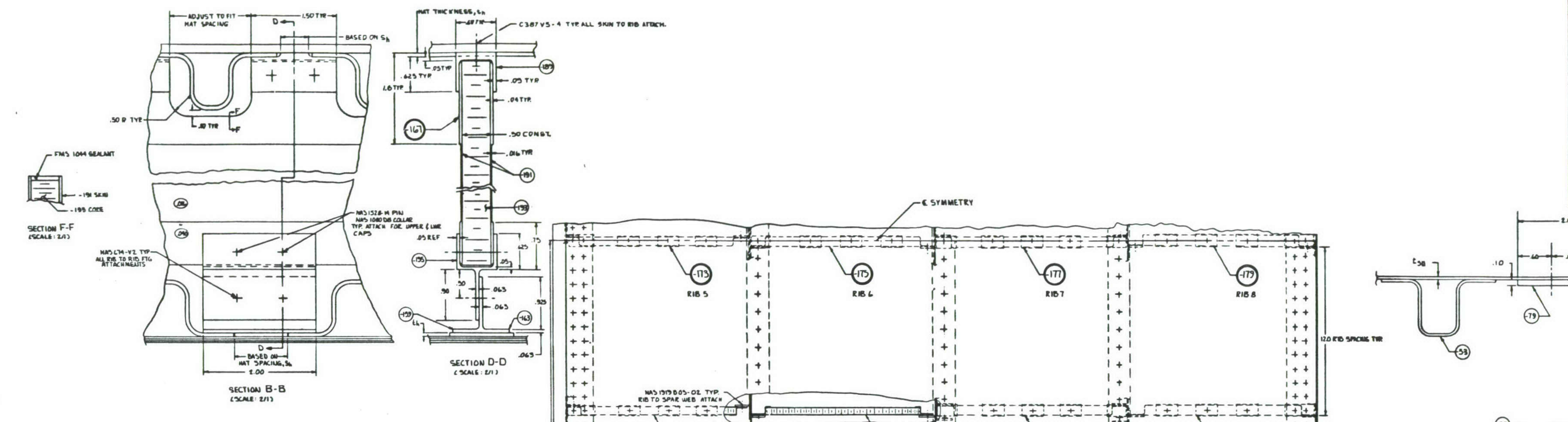


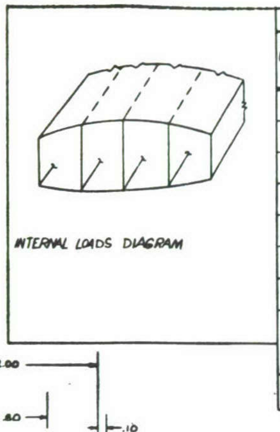
SEE TABLE 1. FOR LOWER SKIN DETAILS

PANEL DIMENSIONS

	PART NAME	DIM.	BAY 1 DASH	BAY 1 DIM.	BAY 2 DASH	BAY 2 DIM.	BAY 3 DASH	BAY 3 DIM.	BAY 4 DASH	BAY 4 DIM.
UPPER	SKIN	t_{SU}	-21	.150	-21	.150	-21	.150	-21	.041
UPPER	HATS	t_h	-23 THRU -29	.071	-31 THRU -37	.071	-39 THRU -45	.060	-47 THRU -53	.045
UPPER	HATS	H_h		1.25		1.00		1.00		1.00
UPPER	HATS	L_h		2.247		2.247		2.170		2.025
UPPER	HATS	S_h		.528		.628		.555		.750
LOWER	SKIN	$t_{SL\text{-}IN.}$	-85	.035	-87	.035	-89	.035	-91	.016
LOWER	SKIN	$t_{SL\text{-}MID}$	-93	.032	-95	.032	-97	.032	-99	.025
LOWER	SKIN	$t_{SL\text{-}OUT}$	-101 THRU -109 - .032 CONST. FOR ALL BAYS.							
LOWER	HATS	t_h	-111 THRU -117	.071	-119 THRU -125	.071	-127 THRU -133	.071	-135 THRU -141	.045
LOWER	HATS	H_h		1.00		1.00		1.00		1.00
LOWER	HATS	L_h		2.247		2.247		2.247		2.025
LOWER	HATS	S_h		.968		.968		1.08		1.19







ANALYTICAL ASSY~ CONCEPT DATA SUMMARY — 610RA001

DASH NO.	PART NAME	NO. REQ'D	RAW STOCK SIZE	RAW STOCK WEIGHT	MAT'L	MAT'L PROPS APPLICABLE TO CRIT. STRESS	STATIC LIMIT DES STRESS	MAX. OPERATING STRESS	K_T	ALLOW FATIGUE STRESS	FRACT. TOUGH.	K_{ISCC}	DAM TOL. CLASS	INSPECT-ABILITY CLASS	CRIT. CRACK LENGTH	MIN. NDI METHOD	ALLOW FRACT STRESS	FIN. WT. IN LBS.	COST IN DOLLARS
-7	UPPER PANEL	1	SEE TABLE BELOW	92.72	6AL-4V STA	F_{tu} = 132 KSI	F = 92.5 KSI (73.1)	73.3 KSI	—	—						.100/UT, PEN, X-RAY	—	73.49	1,001.02
-9	FWD SPAR	1		15.44	SEE TABLE BELOW											.156/UT, PEN, X-RAY		10.01	284.56
-11	FWD AUX SPAR	1		18.20		F_{tu} = 175 KSI	F = 112 KSI (85.0)	85.0 KSI	3.0	28.5 KSI NOTE 3	80		F.S.		.436 SURFACE		102.5 KSI	9.84	407.40
-13	CTR SPAR	1		19.98														10.51	424.38
-15	AFT AUX SPAR	1		18.99														9.89	395.12
-17	AFT SPAR	1		14.35	SEE TABLE BELOW											.150/UT, PEN X-RAY		8.62	311.38
-19	LWR PANEL	1		105.63	8-8-2-3 STA											.100/UT, PEN. X-RAY		89.37	2,238.00
-165 THRU -187	RIB 1 THRU RIB 12	1 EA	SEE TABLE BELOW	2.83 EACH	SEE TABLE BELOW											.152/UT, PEN, X-RAY		2.37 EACH 28.44 TOTAL	848.96
-1 ASSY																			3,000.00
																		246.17	8476.66

DASH NO.	PART NAME	NO. REQ'D	RAW STOCK SIZE	RAW STOCK WEIGHT	MAT'L
-7	UPP'R PANEL	-	-	(92.72)	-
-21	SKIN	1	.15 X 48 X 59.1	61.2	6AL-4V STA
-23	HAT, 1	1	.071 X 4.5 X 48	2.46	
-25	,2	1			
-27	,3	1			
-29	,4	1	.071 X 4.5 X 48	2.46	
-31	,5	1	.071 X 4.0 X 48	2.18	
-33	,6	1			
-35	,7	1			
-37	,8	1	.071 X 4.0 X 48	2.18	
-39	,9	1	.060 X 4.0 X 48	1.85	
-41	,10	1			
-43	,11	1			
-45	,12	1	.060 X 4.0 X 48	1.85	
-47	,13	1	.045 X 4.0 X 48	1.39	
-49	,14	1			
-51	,15	1			
-53	HAT ,16	1	.045 X 4.0 X 48	1.39	6AL-4V STA
-9	FWD. SPAR	–	–	(15.44)	–
-55	UPPER CAP	1	.5 X 2.2 X 48 EXTR	5.0	6AL-4V STA
-57	WEB	1	.12 X 8.5 X 48	8.56	8-8-2-3 STA
-59	STIFFENERS	28	.08 X 5.5 X .8" EACH	2.14 TOTAL	8-8-2-3 STA
-11	FWD AUX. SPAR	–	–	(18.2)	–
-61	UPPER CAP	1	.5 X 1.4 X 48 EXTR	2.93	6AL-4V STA
-63	WEB	1	.12 X 11 X 48	11.10	8-8-2-3 STA
-65	STIFFENERS	56	.05 X 1 X .85 EACH	4.17 TOTAL	8-8-2-3 STA
-13	CTR. SPAR	–	–	(19.98)	–
-67	UPPER CAP	1	.5 X 1.4 X 48 EXTR	2.93	6AL-4V STA
-69	WEB	1	.12 X 12.2 X 48	12.3	8-8-2-3 STA
-71	STIFFENERS	52	.05 X 1.1 X .95 EACH	4.75 TOTAL	8-8-2-3 STA
-15	AFT AUX. SPAR	–	–	(18.99)	—
-73	UPPER CAP	1	[illegible] 48 EXTR	2.93	6AL-4V STA
-75	WEB	1	.12 X 11.8 X 48	11.9	8-8-2-3 STA
-77	STIFFENERS		.05 X 1.1 X .9 EACH	4.16 TOTAL	8-8-2-3 STA
-17	AFT SPAR	-	-	(14.35)	-
-79	UPPER CAP	1	[illegible] 48 EXTR	3.2	6AL-4V STA
-81	WEB	1	.10 X 10.5 X 48	8.65	8-8-2-3 STA
-83	STIFFENERS	40	.05 X 1.1 X .5 EACH	2.50 TOTAL	8-8-2-3 STA
-19	LWR PANEL			(105.63)	8-8-2-3 STA
-85	INNER SKIN, 1	1	[illegible]	[illegible]	
-87		1	[illegible]	[illegible]	
-89	,3	1	[illegible]	[illegible]	
-91	INNER SKIN, 4	1	[illegible]	[illegible]	
-93	MIDDLE SKIN, 1	1	[illegible]	[illegible]	
-95		1	[illegible]	[illegible]	
-97		1	[illegible]	[illegible]	
-99	MIDDLE SKIN, 4	1	[illegible]	[illegible]	
-101	OUTER SKIN, 1	1	[illegible]	[illegible]	
-103		1	[illegible]	[illegible]	
-105		1	[illegible]	[illegible]	
-107		1	[illegible]	[illegible]	
-109	OUTER SKIN, 5	1	[illegible]	[illegible]	
-111	HAT, 1	1	[illegible]	[illegible]	
-113	,2	1			
-115	,3	1			
-117	,4	1			
-119	,5	1			
-121	,6	1			
-123	,7	1			
-125	,8	1			
-127	,9	1			
-129	,10	1			
-131	,11	1			
-133	,12	1			
-135	,13	1			
-137	,14	1			
-139	,15	1			
-141	HAT ,16	1	[illegible]	[illegible]	
-143	SPAR CAP, F.S.	1	[illegible]	[illegible]	
-145	SPAR CAP, FAS. FWD.	1	[illegible]	[illegible]	8-8-2-3 STA
-147	SPAR CAP, FAS. AFT	1	.145 X 3.4 X 48	3.78	8-8-2-3 STA
-149	C.S. FWD.	1			
-151	C.S. AFT	1			
-153	A.A.S. FWD.	1			
-155	A.A.S. AFT	1			
-157	SPAR CAP, AFT SPAR	1	[illegible]	[illegible]	8-8-2-3 STA
-159	SKIN, .071	[illegible]	[illegible]	[illegible]	[illegible]
-161	SKIN, .045	[illegible]	[illegible]	[illegible]	[illegible]
-163	RIB FTG.	[illegible]	[illegible]	[illegible]	[illegible]
-165	RIB 1				
-189	UPPER CAP	[illegible]	[illegible]	[illegible]	[illegible]
-191	SKIN	[illegible]	[illegible]	[illegible]	[illegible]
-193	CORE	[illegible]	[illegible]	[illegible]	[illegible]
-195	LWR CAP	[illegible]	[illegible]	[illegible]	[illegible]
-167	RIB 2				
-169	RIB 3				
-171	RIB 4				
-173	RIB 5				
-175	RIB 6				
-177	RIB 7				
-179	RIB 8				
-181	RIB 9				
-183	RIB 10				
-185	RIB 11				
-187	RIB 12				
	ADHESIVE	AE	AE	6.00	[illegible]
	SEALANT	AE	AE	2.00	[illegible]
	PIN	144	-		[illegible]
	COLLAR	144	-		[illegible]
	LOCK BOLT	120	-		[illegible]
	BOLT	213	-		[illegible]
	BOLT	147	-		[illegible]
	BOLT	576	-		[illegible]
	NUT	588	-		[illegible]
	NUT	147	-		[illegible]

NOTES ÷ 1 SPARS AND HATS ARE ON PERCENT LINES
2 ALL BEND RADII BASED ON 5.5T INSIDE RAD.
3 VALUE ASSUMED PENDING TEST RESULTS

PRELIMINARY DESIGN DRAWING

ADHESIVE BONDED LAMINATED [illegible] WITH BONDED HAT STIFFENERS - TITANIUM

GENERAL DYNAMICS
Convair Aerospace Division
Fort Worth Operation

610RA-007

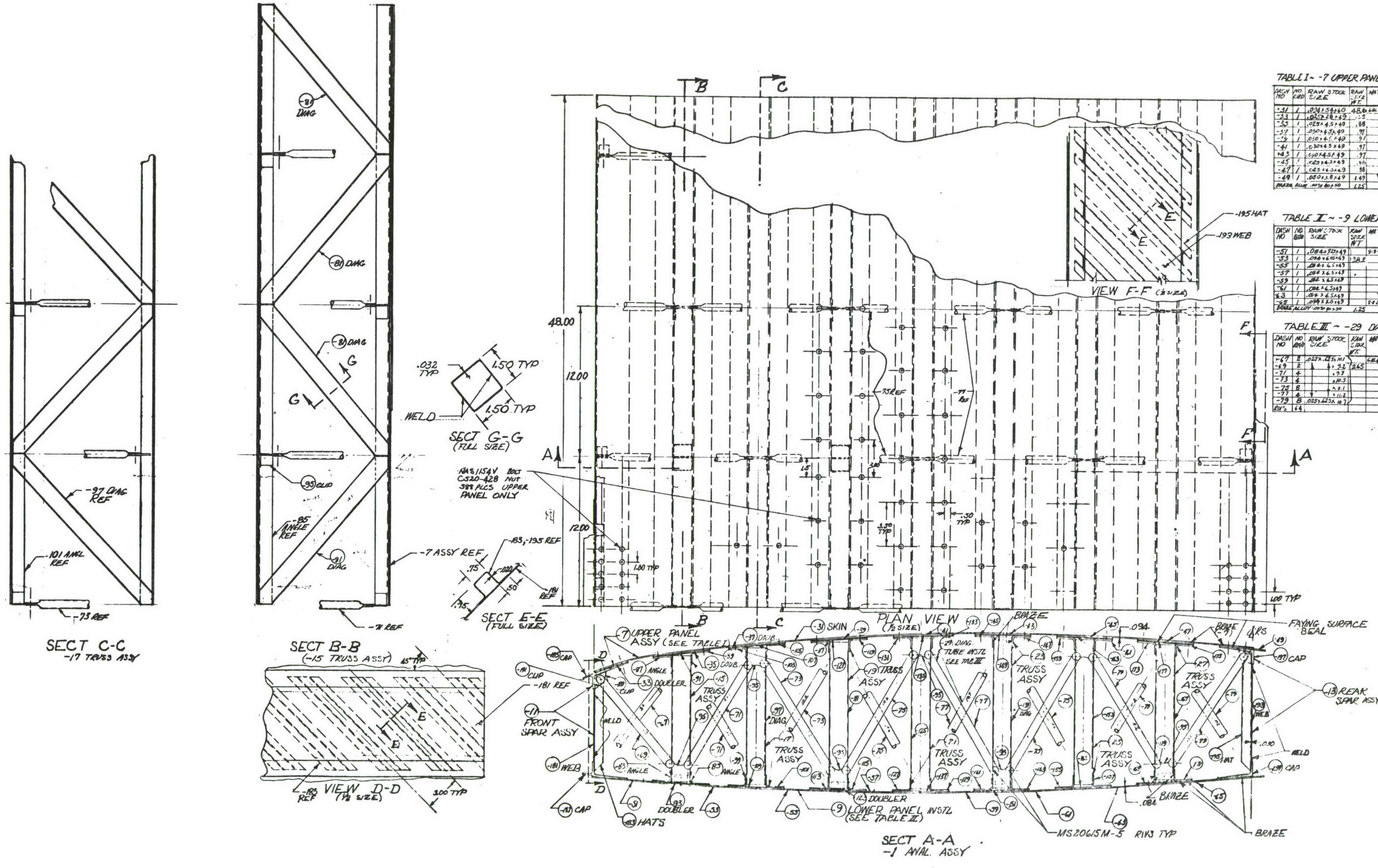


TABLE I ~ -7 UPPER PANEL PARTS

TABLE II ~ -9 LOWER PANEL PARTS

TABLE III ~ -29 DIAG TUBE INSTL PARTS

ANALYTICAL ASSY~ CONCEPT DATA SUMMARY																				610RA008
DASH NO.	PART NAME	NO. REQ'D	RAW STOCK SIZE	RAW STOCK WEIGHT	MAT'L	MAT'L PROP'S APPLICABLE TO CRIT. STRESS	STATIC LIMIT DES STRESS	MAX. OPERATING STRESS	K_T	ALLOW FATIGUE STRESS	FRACT. TOUGH.	K_{cr}	DAM TOL. CLASS.	INSPECT-ABILITY CLASS.	CRIT. CRACK LENGTH TYPE	MIN. NDT DETECT CRACK LENGTH	ALLOW. FRACT. STRESS	FIN. WT. IN LBS.	COST IN DOLLARS	
-7	UP. PAN'L ASSY.	1	SEE		TABLE I	F_t = 155 KSI	F_t = 103.3 (82.1)	82.1 KSI	—	—						.15/UT	—	47.79	1209.58	
-9	LOW. PAN'L INSTL.	1			II	F_t = 175 KSI	F = 116.0 (92.2)	92.2 KSI	1.0	>92.2 KSI SEE NOTE 1	80		F.S	DEPOT	.395 SURFACE	.15/UT	103.0 KSI	38.61	621.61	
-11	FRN'T SPAR ASSY	1			V	F_t = 90	F_t = 60.0 (47.7)	F_T = 71.6 KSI SEE NOTE 2	3.0	71.6 KSI SEE NOTE 1			F.S	DEPOT		.12/UT, PEN	103.0 KSI	12.41	327.46	
-13	REAR SPAR ASSY	1			V	F_t = 90	F_t = 19.9 (15.8)	F_T = 54.6 KSI SEE NOTE 2	3.0	54.6 KSI SEE NOTE 1			F.S	DEPOT		.12/UT, PEN	103.0 KSI	12.51	341.15	
-15	TRUSS ASSY.	1			IV											.12/UT PEN		11.89	230.61	
-17	TRUSS ASSY.	1																12.02	232.34	
-19	TRUSS ASSY.	1				F_t = 121 REF NOTE 5	F_t = 80.8 (64.2)	F_T = 64.2 KSI	1.0	64.2 KSI			F.S.	DEPOT			97 KSI	12.16	234.79	
-21	TRUSS ASSY.	1				F_T = 165 REF NOTE 4	F_T = 110.9 (88.1)	F_T = 88.1 KSI	1.0	88.1 KSI			F.S.	DEPOT			102 KSI REF NOTE 3	12.14	234.21	
-23	TRUSS ASSY.	1																12.12	234.07	
-25	TRUSS ASSY.	1																12.10	233.78	
-27	TRUSS ASSY.	1			IV											.12/UT PEN		12.04	232.63	
-29	DIAG. TUBE INSTL.	1			III	F_T = 121	F_t = 26.9 (21.4)	F_T = 21.4 KSI	4.5	34.6 KSI			F.S.	DEPOT			58 KSI	2.63	54.93	
-1 INST	BOLTS	388 NAS1154V																2.51	10,779.18	
	NUTS	388 C-520																		
																		220.94	15,362.16	

TABLE IV ~ -15 THRU -27 TRUSS ASSY PARTS

TABLE IV (CONTINUED)

TABLE V ~ FRNT & REAR SPAR ASSY PARTS

NOTES:
1. ASSUMED VALUE PENDING TEST RESULTS
2. STRESS DUE TO OVERALL BENDING AT LEVEL OF THE WELD
3. ASSUMED SAME AS 8-8-2-3 Ti
4. DATA SHOWN IS FOR LOWER ANGL (-89, -23) - TYP FOR TRUSS ASSY
5. DATA SHOWN IS FOR DIAG. (-11) - TYPICAL FOR TRUSS ASSY

PRELIMINARY DESIGN DRAWING

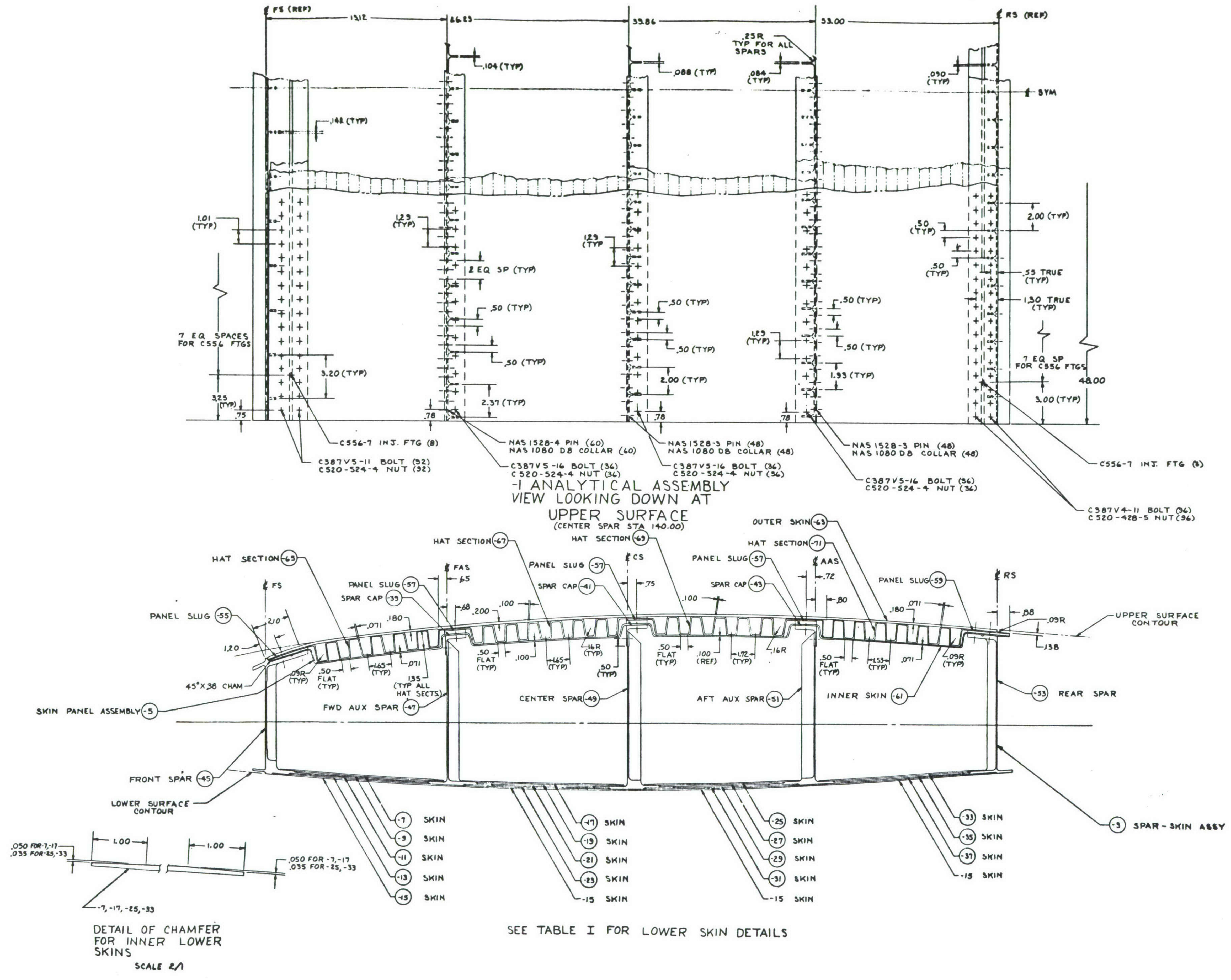
ANALYTICAL ASSY. ~ BRAZED SPACE TRUSS WING (CSS 1400)

SCALE 1/4 & 1/1 DATE 1-5-73

GENERAL DYNAMICS
Convair Aerospace Division
Fort Worth Operation

610RA008

SHEET 1 OF 1



SEE TABLE I FOR LOWER SKIN DETAILS

-1 ANALYTICAL ASSEMBLY - CONCEPT DATA SUMMARY																			610RA009
DASH NO.	PART NAME	NO. REQD	RAW STOCK SIZE	RAW STOCK WT.	MATL.	MATL. PROPS APPLICABLE TO CRIT. STRESS	STATIC LIMIT DES STRESS ($F \times 1.5/1.25$)	MAX OPERATING STRESS	K_T	ALLOW. FATIGUE STRESS	FRACT TOUGH. K_c KSI√in	K_{ISCC}	DAM TOL CLASS	INSPECTABILITY CLASS	CRIT. CRACK LENGTH TYPE	MIN. NDI DEFECT CRACK LENGTH METH	ALLOW. FRACT. STRESS	FIN. WEIGHT IN LBS.	COST IN DOLLARS
-3	SPAR-SKIN ASSY	1	–	–	–											.18/UT			
-45	FRONT SPAR	1	[illegible]	238.10	7050 T76 AL	[illegible]	[illegible]	86.4 KSI	8.0	[illegible]			[illegible]				43.8 KSI	14.85	529.[illegible]
-47	FWD AUX SPAR	1	EXTR	109.00	AL													10.14	457.[illegible]
-49	CENTER SPAR	1	EXTR	128.85	AL													11.75	533.[illegible]
-51	AFT AUX SPAR	1	EXTR.	115.14	AL													9.05	483.[illegible]
-53	REAR SPAR	1	[illegible]	253.20	7050 T76 AL													16.46	576.[illegible]
	ALL LOWER SKINS (SEE TABLE I)					[illegible]	[illegible]	36.0 KSI	1.0	[illegible]	78		[illegible]		[illegible]		70.0 KSI	88.22	118.[illegible]
	ADHESIVE		63.30 SQ.FT.															6.33	81.[illegible]
-5	SKIN PANEL ASSY					[illegible]	[illegible]	[illegible]	–	–	78				[illegible]	100/UT	–		
	ALL DETAILS (SEE TABLE II)																	134.77	393.[illegible]
-39	SPAR CAP	1	EXTR.	2.90														2.04	8.[illegible]
-41	SPAR CAP	1	EXTR.	2.88														2.02	8.[illegible]
-43	SPAR CAP	1	EXTR.	2.88														2.02	8.[illegible]
C387V4-11	BOLT	96			TI													.83	35.[illegible]
C387V5-16	BOLT	108			TI													1.99	52.[illegible]
C387V5-11	BOLT	92			TI													1.37	70.[illegible]
C520-524-4	NUT	200			STL													1.89	110.[illegible]
C520-428-5	NUT	96			STL													.65	76.[illegible]
C556-7	INJ FTG	16			TI													.09	16.[illegible]
NAS1528-3	PIN	96			AL													.19	18.[illegible]
NAS1528-4	PIN	60			AL													.12	11.[illegible]
NAS1080DB	COLLAR	156			AL													.32	5.[illegible]
-1	ASS'Y																		1,229.[illegible]
															GRAND TOTAL			300.00	4,172.[illegible]

TABLE I

DETAILS OF LOWER SURFACE SKINS

DASH NO.	RAW STOCK SIZE	RAW STOCK WT.	MATERIAL	FINISHED STOCK SIZE	FINISHED WT. IN LBS.
-7	.100X12.40X48.50	6.01	7050-T76 ALUMINUM ALLOY SHEET	.100X11.90X48.00	5.71
-9	.100X11.25X48.50	5.46		.100X10.75X48.00	5.18
-11	.100X8.00X48.50	3.88		.100X7.50X48.00	3.60
-13	.100X10.50X48.50	5.09		.100X10.00X48.00	4.80
-15	.100X53.00X48.50	25.71		.100X52.50X48.00	25.20
-17	.100X12.25X48.50	5.94		.100X11.75X48.00	5.66
-19	.100X11.15X48.50	5.41		.100X10.65X48.00	5.14
-21	.100X7.85X48.50	3.81		.100X7.35X48.00	3.55
-23	.100X10.95X48.50	5.31		.100X10.45X48.00	5.04
-25	.071X11.85X48.50	4.08		.071X11.35X48.00	3.87
-27	.071X9.45X48.50	3.25		.071X8.95X48.00	3.05
-29	.071X7.40X48.50	2.55		.071X6.90X48.00	2.35
-31	.071X11.60X48.50	4.00		.071X11.12X48.00	3.79
-33	.080X12.50X48.50	4.95		.080X12.00X48.00	4.61
-35	.080X10.25X48.50	3.98		.080X9.75X48.00	3.75
-37	.080X8.10X48.50	3.14		.080X7.62X48.00	2.93

TABLE II

-5 SKIN PANEL ASSEMBLY

DASH NO.	PART NAME	RAW STOCK SIZE	RAW STOCK WT.	MATERIAL	FINISHED STOCK SIZE	FINISHED WT. IN LBS.	NO. REQD
-55	PANEL SLUG	.250X3.05X54.00	4.12	7050-T76 ALUMINUM ALLOY SHEET	—	1.35	1
-57	PANEL SLUG	.312X1.75X54.00	2.95		—	2.02	3
-59	PANEL SLUG	.160X3.25X54.00	2.80		—	2.16	1
-61	INNER SKIN	.100X66.50X60.00	39.90		—	25.35	1
-63	OUTER SKIN	.250X59.00X60.00	88.50		—	48.40	1
-65	HAT SECTION	.071X34.25X60.00	14.59		.071X28.25X48.00	9.60	1
-67	HAT SECTION	.100X36.75X60.00	22.05		.100X30.75X48.00	14.78	1
-69	HAT SECTION	.100X34.75X60.00	20.85		.100X28.75X48.00	13.82	1
-71	HAT SECTION	.071X37.35X60.00	15.91		.071X31.35X48.00	10.70	1
—	ADHESIVE	25.50 SQ. FT.	—	AF143 (3M)	—	2.55	—

4. VALUE ASSUMED PENDING TEST RESULTS
3. INSTALL C556 INJECTION FITTINGS PER M076 EQUALLY SPACED BETWEEN FASTENERS AS SHOWN AND CENTERED ON THE SEALING GROOVE. PLUG WITH NAS1081-06A3 SCREWS.
2. THE FAYING SURFACES AT THE FRONT AND REAR SPARS AND ALL FASTENERS, SHALL BE SEALED PER FPS-1004.
1. USE AF143 ADHESIVE (3M COMPANY) BETWEEN ALL LOWER SURFACE SKINS AND ALL ADJACENT SPARS AND BETWEEN ALL HAT SECTIONS, SLUGS AND UPPER AND LOWER SKINS.

NOTES:—

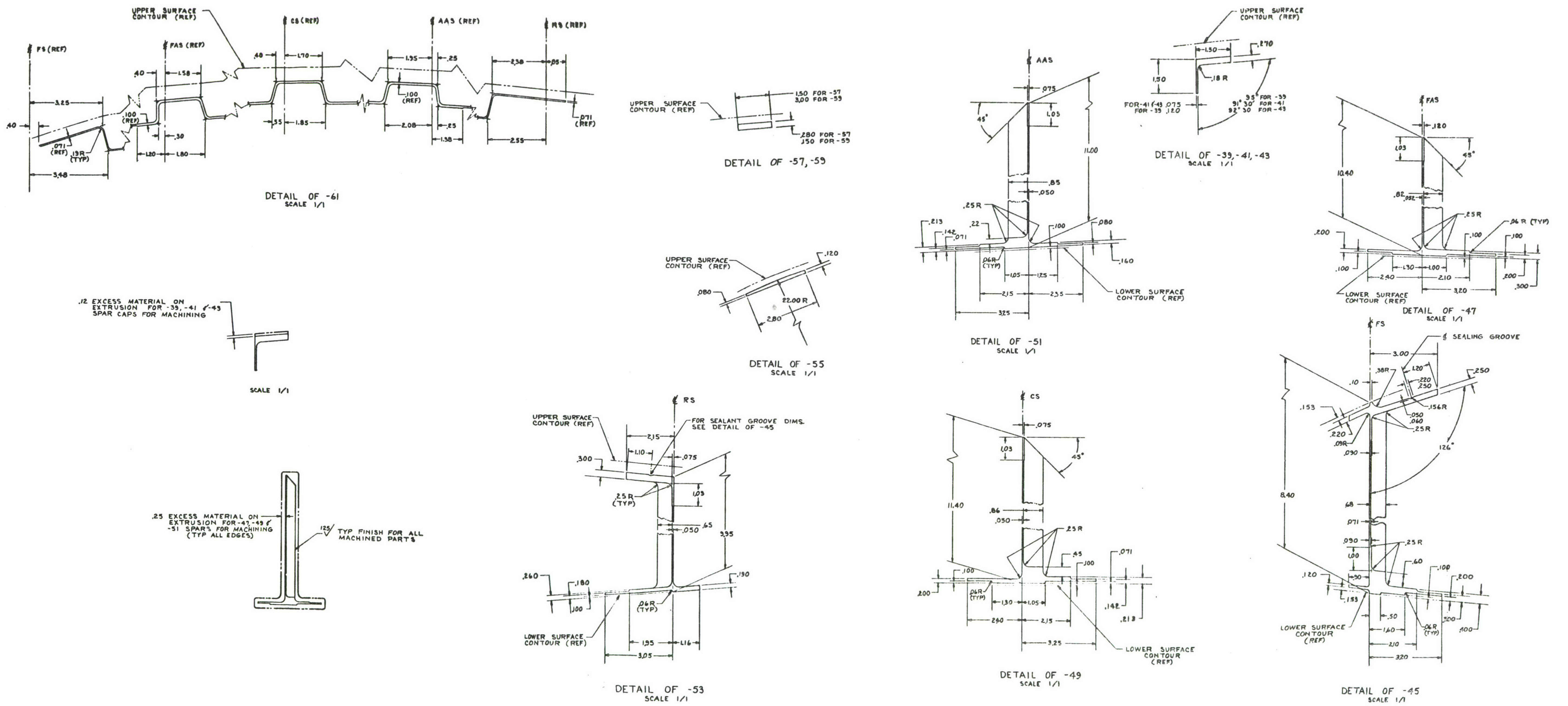
PRELIMINARY DESIGN DRAWING

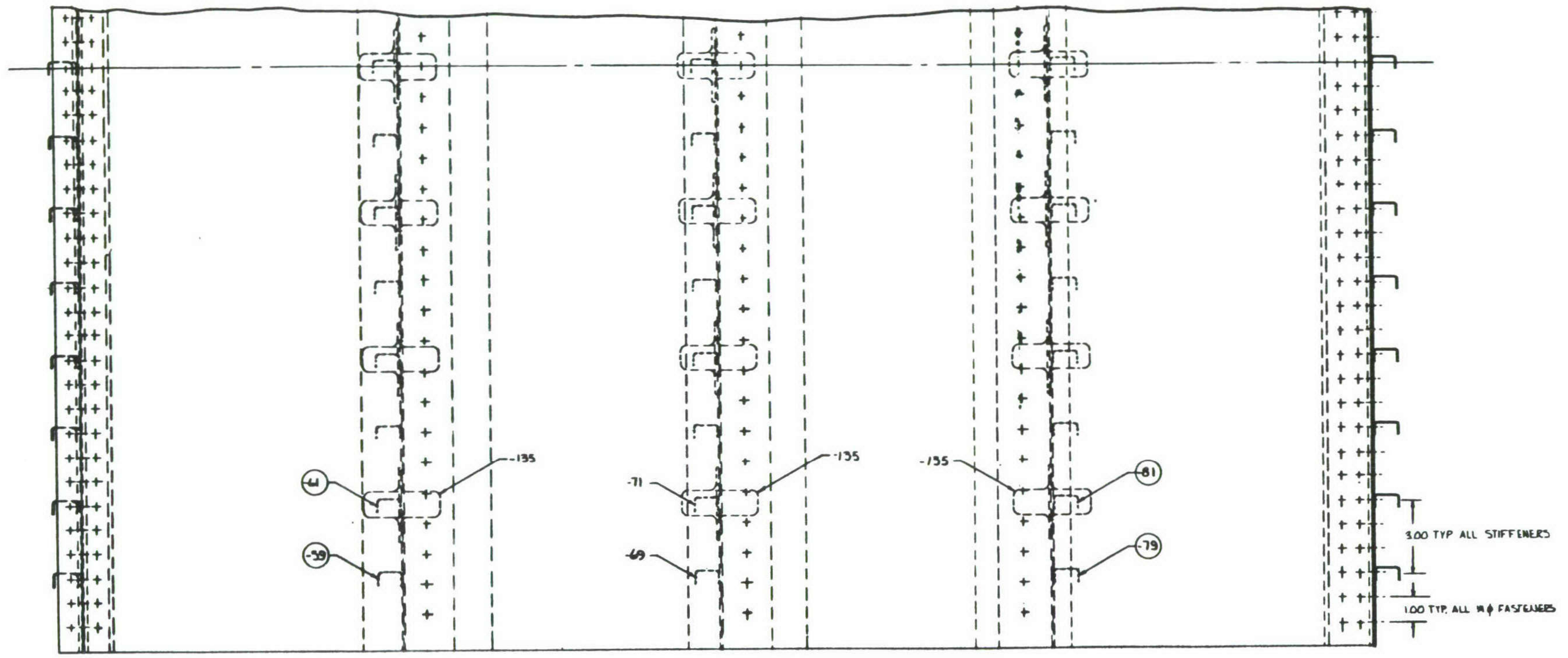
ANALYTICAL ASSY–MODIFIED TRIANGLE CORE, ADHESIVE BONDED ALUMINUM

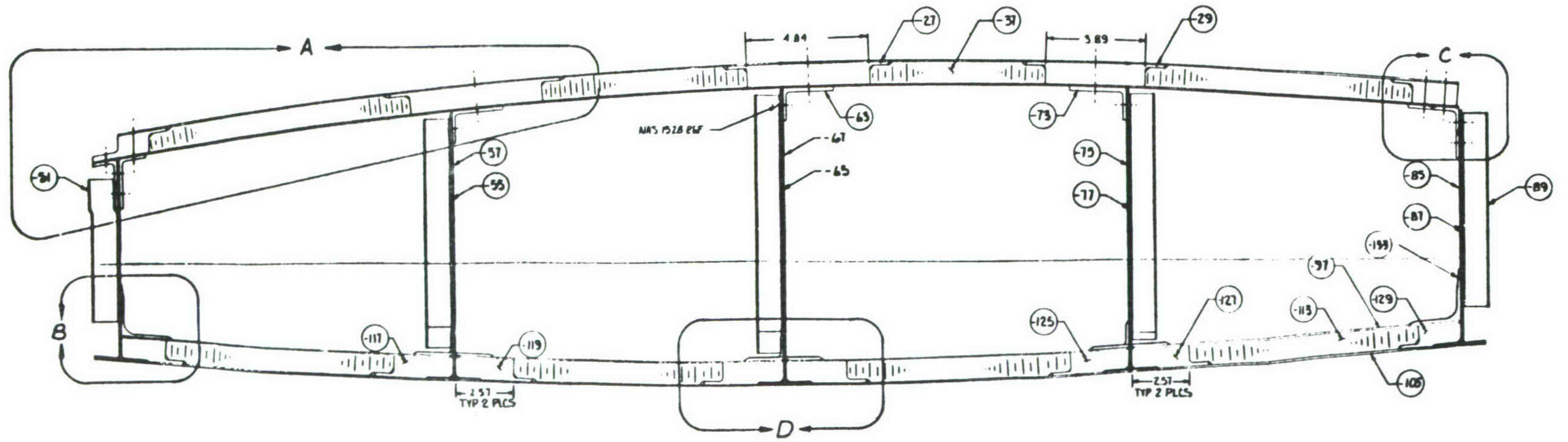
GENERAL DYNAMICS Convair Aerospace Division

610RA009

Sheet 1

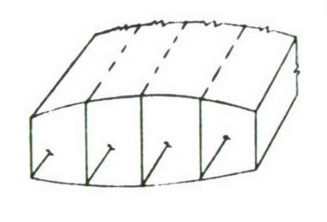

DETAIL OF -61
SCALE 1/1
DETAIL OF -57, -59
DETAIL OF -55
SCALE 1/1
DETAIL OF -51
SCALE 1/1
DETAIL OF -39, -41, -43
SCALE 1/1
DETAIL OF -47
SCALE 1/1
.12 EXCESS MATERIAL ON EXTRUSION FOR -39, -41 & -43 SPAR CAPS FOR MACHINING
SCALE 1/1
.25 EXCESS MATERIAL ON EXTRUSION FOR -47, -49 & -51 SPARS FOR MACHINING (TYP ALL EDGES)
TYP FINISH FOR ALL MACHINED PARTS
FOR SEALANT GROOVE DIMS. SEE DETAIL OF -45
DETAIL OF -53
SCALE 1/1
DETAIL OF -49
SCALE 1/1
DETAIL OF -45
SCALE 1/1
UPPER SURFACE CONTOUR (REF)
LOWER SURFACE CONTOUR (REF)
℄ SEALING GROOVE





DASH NO.	PART NAME	NO REQ'D	RAW STOCK SIZE	RAW STOCK WT.	MAT'L
-7	UPP'R PANEL	-	-	(132.3)	-
-21	OUTER SKIN	1	.07 X 54 X 56	21.6	AL 7050-T76
-23	SLUG, 1	1	1.0 X 30 X 54	16.5	AL 7050 T7651
-25	,2	1	1.0 X 6.75 X 54	37.2	
-27	,3	1	1.0 X 6.5 X 54	35.8	
-29	,4	1	1.0 X 5.5 X 54	30.3	
-31	SLUG ,5	1	1.0 X 2.5 X 54	13.8	AL 7050 T7651
-33	CORE , 1	1	1.00 X 11 X 54	1.55	P006-18
-35	,2	1	1.00 X 9 X 54	1.27	
-37	,3	1	1.00 X 8 X 54	1.15	
-39	CORE ,4	1	1.00 X 11 X 54	1.55	P006-18
-41	INNER SKIN	1	.07 X 54 X 56	21.6	AL 7050-T76
-9	FWD. SPAR	-	-	(14.76)	-
-43	UPP'R.CAP, FWD.	1	.25 X 3.5 X 54 EXTR.	4.82	AL 7050-T76
-45	UPP'R. CAP, AFT	1	.25 X 3.5 X 54 EXTR.	4.82	
-47	WEB, FWD.	1	.04 X 9 X 54	1.985	
-49	WEB, AFT	1	.04 X 9 X 54	1.985	
-51	STIFFENER	15	.05 X 2.5 X 6 EACH	1.15 TOTAL	AL 7050-T76
-11	FWD. AUX. SPAR	-	-	(11.35)	-
-53	UPP'R. CAP	1	.25 X 3.5 X 54 EXTR.	4.82	AL 7050-T76
-55	WEB, FWD.	1	.036 X 12 X 54	2.38	
-57	WEB, AFT	1	.036 X 12 X 54	2.38	
-59	STIFFENER, LONG	8	.05 X 2.5 X 9.75 EACH	.99 TOTAL	
-61	STIFFENER, SHORT	7	.05 X 2.5 X 6.75 EACH	.78 TOTAL	AL 7050-T76
-13	CTR. SPAR	-	-	(11.758)	-
-63	UPP'R. CAP	1	.25 X 3.5 X 54 EXTR.	4.82	AL 7050-T76
-65	WEB, FWD.	1	.035 X 14 X 54	2.50	
-67	WEB, AFT	1	.035 X 14 X 54	2.50	
-69	STIFFENER, LONG	8	.05 X 2.5 X 10.5 EACH	1.07 TOTAL	
-71	STIFFENER, SHORT	7	.05 X 2.5 X 9.75 EACH	.868 TOTAL	AL 7050-T76
-15	AFT AUX. SPAR	-	-	(11.708)	-
-73	UPP'R. CAP	1	.25 X 3.5 X 54 EXTR.	4.82	AL 7050-T76
-75	WEB, FWD.	1	.035 X 13 X 54	2.5	
-77	WEB, AFT	1	.035 X 13 X 54	2.5	
-79	STIFFENER, LONG	8	.05 X 2.5 X 10 EACH	1.02 TOTAL	
-81	STIFFENER, SHORT	7	.05 X 2.5 X 9.75 EACH	.868 TOTAL	AL 7050-T76
-17	AFT SPAR	-	-	(10.64)	-
-83	UPP'R. CAP	1	.25 X 4 X 54 EXTR.	5.5	AL 7050-T76
-85	WEB, FWD.	1	.03 X 10.75 X 54	1.78	
-87	WEB, AFT	1	.03 X 10.75 X 54	1.78	
-89	STIFFENER	15	.05 X 2.5 X 8.25 EACH	1.58 TOTAL	AL 7050-T76

DASH NO.	PART NAME	NO REQ'D	RAW STOCK SIZE	RAW STOCK WT.	MAT'L
-19	LWR PANEL	-	-	(207.779)	-
-91	INNER SKIN, 1	1	.07 X 19 X 54	5.9	AL 7050-T76
-93	,2	1	.07 X 13.75 X 54	5.3	
-95	,3	1	.07 X 14.25 X 54	5.5	
-97	INNER SKIN, 4	1	.07 X 19 X 54	5.9	
-99	OUTER SKIN, 1	1	.07 X 13 X 54	5.01	
-101	,2	1	.07 X 19 X 54	5.9	
-103	,3	1	.07 X 14.5 X 54	5.59	
-105	OUTER SKIN ,4	1	.07 X 17 X 54	6.55	AL 7050-T76
-107	CORE , 1	1	1.0 X 9.5 X 54	1.335	P006-18
-109	,2	1	1.0 X 9 X 54	1.265	
-111	,3	1	1.0 X 9.5 X 54	1.335	
-113	CORE ,4	1	1.0 X 9.5 X 54	1.335	P006-18
-115	SLUG, 1	1	1.0 X 2.75 X 54	15.15	AL 7050-T7651
-117	,2	1	1.0 X 3.5 X 54	19.3	
-119	,3	1			
-121	,4	1			
-123	,5	1			
-125	,6	1			
-127	,7	1	1.0 X 3.5 X 54	19.3	
-129	SLUG ,8	1	1.0 X 2.75 X 54	15.15	AL 7050-T7651
-131	SPAR ANGLE, FWD.	1	.25 X 4 X 54 EXTR.	5.51	AL 7050 EXTRUSION
-133	SPAR ANGLE, AFT	1	.25 X 4 X 54 EXTR.	5.51	AL 7050 EXTRUSION
-135	PRESSURE STRAP	21	AR	1.239 TOTAL	ALUMINUM CASTING
-	ADHESIVE	AR	AR	12.0	FMS 1013
-	BOLT	188	-	.376	NAS 1518
-	BOLT	111	-	.222	NAS 1520
-	BOLT	329	-	1.316	NAS 1528



INTERNAL LOADS DIAGRAM

ANALYTICAL ASSY ~ CONCEPT DATA SUMMARY — 610RA-010

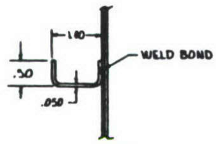
DASH NO.	PART NAME	NO REQ'D	RAW STOCK SIZE	RAW STOCK WEIGHT	MAT'L	MAT'L PROP'S APPLICABLE TO CRIT. STRESS	STATIC LIMIT LD STRESS (F X 1.5/1.33)	MAX OPERATING STRESS	K_T	ALLOW FATIGUE STRESS	FRACT. TOUGH. K_{IC} KSI √IN	K_{ISCC}	DAM. TOL. CLASS	INSPECTABILITY CLASS	CRIT. CRACK LENGTH / TYPE	MIN. NDI DETECT CRACK LEN / METH.	ALLOW FRACT. STRESS KSI	FIN. WT IN LBS.	COST IN DOLLARS
-7	UPP'R PANEL	1	SEE TABLE	132.3	SEE TABLE	F_{tu} = 68 KSI (F_{ty} = 62.5)	F = 45.33 KSI (36.03)	36.03 KSI	—	—			—	—		.100 UT PEN	—	120.35	304.[illegible]
9	FWD SPAR	1		14.76		F_{tu} = 70 KSI	F = 37.65 (29.93)	29.93 KSI	1.0	37.30 KSI			F.S.	NON-INSPECTABLE		.150/UT PEN X-RAY	42.7 KSI	8.353	79.[illegible]
-11	FWD AUX SPAR	1		11.35		F_{tu} = 70 KSI	F = 35.23 (28.00)	28.00 KSI	2.5	30.00 KSI			F.S.	NON-INSPECTABLE		.150/UT PEN X-RAY	42.7 KSI	8.037	47.11
-13	CTR. SPAR	1		11.758		F_{tu} = 70 KSI	F = 35.39 (28.29)	28.29 KSI	2.5	30.00 KSI			F.S.	NON-INSPECTABLE		.150/UT PEN X-RAY	42.7 KSI	8.192	47.60
-15	AFT AUX SPAR	1		11.708		F_{tu} = 70 KSI	F = 31.59 (25.11)	25.11 KSI	2.5	30.00 KSI			F.S.	NON-INSPECTABLE		.150/UT PEN X-RAY	42.7 KSI	7.999	47.54
-17	AFT SPAR	1		10.64		F_{tu} = 70 KSI	F = 28.46 (22.62)	22.62 KSI	1.0	37.30 KSI			F.S.	NON-INSPECTABLE		.150/UT PEN X-RAY	42.7 KSI	7.033	47.37
-19	LWR PANEL	1	SEE TABLE	207.779	SEE TABLE	F_{tu} = 70 KSI	F = 42.49 (34.57)	34.57 KSI	1.0	37.30 KSI	75		F.S.	NON-INSPECTABLE	.223 SURFACE FLAW	.100 UT PEN	55.0 KSI	133.06	571.94
-1	ASS'Y																		1,676.32
																		293.06	2,902.10

NOTES ~ 1. SPARS ARE ON PERCENT LINES.

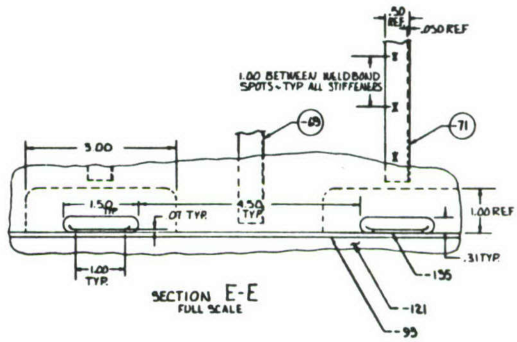
PRELIMINARY DESIGN DRAWING

WING SECTION ~ ALUMINUM HONEYCOMB PANEL, UPPER & LWR.; INTEGRAL LWR. SPAR CAPS; ADHESIVE BONDED	
BY	APPROVED
SCALE 1/2	DATE
GENERAL DYNAMICS Convair Aerospace Division Fort Worth Operation	610RA-010
SHEET	OF

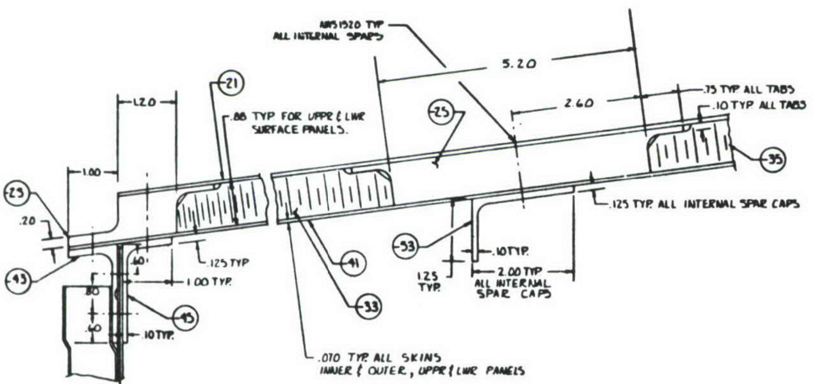
Sheet 1



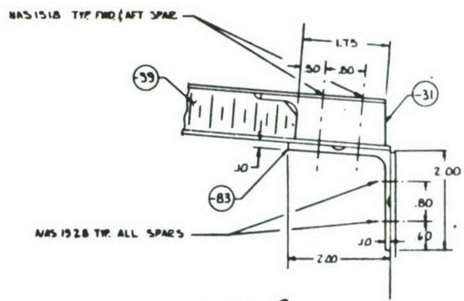
SECTION F-F
FULL SCALE
TYP. ALL STIFFENERS
(-51, -59, -61, -69, -71, -79, -81, -89)



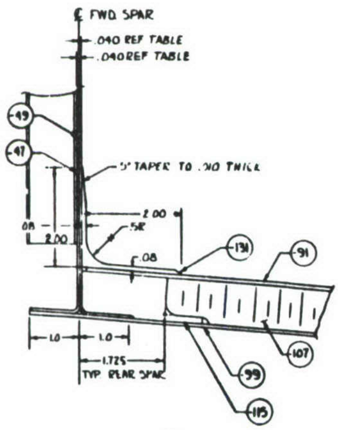
SECTION E-E
FULL SCALE



DETAIL A
FULL SCALE

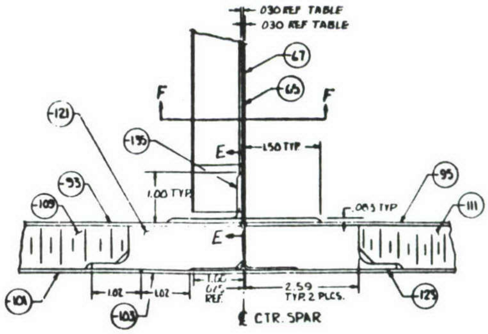


DETAIL C
FULL SCALE



DETAIL B
FULL SCALE

SPAR WEB DASH NO	THICKNESS
-47, -49	.040
-55, -57	.036
-65, -67, -75, & -77	.035
-85, -87	.030



DETAIL D
FULL SCALE

Sheet 2

ANALYTICAL ASSY ~ CONCEPT DATA SUMMARY | 610RA011

DASH NO.	PART NAME	NO. RQD	RAW STOCK SIZE	RAW STOCK WEIGHT	MAT'L	MAT'L PROPS APPLICABLE TO CRIT. STRESS	STATIC LIMIT DES STRESS (F x 1.5/?)	MAX. OPERATING STRESS	K_T	ALLOW FATIGUE STRESS	FRACT. TOUGH. K_c KSI $\sqrt{in}$	K_{ISCC}	DAM TOL. CLASS	INSPECTABILITY CLASS	CRIT. CRACK LENGTH	MIN NDI DETECT. CRACK LENGTH	ALLOW FRACT STRESS	FIN. WT. IN LBS.	COST IN DOLLARS
-7	UP. PANEL ASSY	1	SEE TABLE I →			F_{tu} = 154 KSI	F = 97 KSI (76.5)	76.5 KSI	—	—						.150/UT	—	82.84	1538.36
-9	LWR. PANL ASSY	1				F_{tu} = 175 KSI	F = 112 KSI (89)	89.0 KSI	1.0	>89.0 SEE NOTE 1	80				.395 SURF	.150/UT	102.5 KSI	84.48	2095.46
-11	FRONT SPAR ASSY	1				F_{tu} = 175 KSI	F = 93 KSI (73.5)	73.5 KSI	3.0	>73.5 SEE NOTE 1						.100/PEN. UT	—	9.53	277.09
-13	FRONT AUX SPAR ASSY	1				F_{tu} = 175 KSI												8.80	275.86
-15	CENTER SPAR ASSY	1				F_{tu} = 175 KSI												9.54	287.63
-17	AFT AUX. SPAR ASSY	1				F_{tu} = 175 KSI												8.47	278.05
-19	REAR SPAR ASSY	1				F_{tu} = 175 KSI												10.64	296.57
-127	BHD ASSY	4	SEE TABLE II															4.24	81.09
-129	BHD ASSY	4																5.00	89.36
-131	BHD ASSY	4																4.96	89.36
-133	BHD ASSY	4														.100/PEN. UT		4.68	89.36
-151	CLIP	24	EXTR-	2.70	6AL4V ANN													.93	34.10
-153	CLIP	72	EXTR-	8.40	6AL4V ANN													2.80	104.14
-1 ASSY	RIVETS	712	—	—	TI													.19	28.48
	BOLTS	309	—	—	NAS1154V														386.25
	NUTS	309	—	—	C-520													2.00	154.50
	TANK SEALANT																	.60	
	ASSY COSTS →																		2810.02
																	TOTALS	239.20	8346.75

TABLE I

-7 UPPER PANEL ASSY PARTS

DASH NO	NAME	NO REQ	RAW STOCK SIZE	RAW STOCK WT	MATL	FINISHED PART SIZE	FIN. WT LBS
-21	SKIN	1	.063×54×60	32.7	6AL4V STA	.063×53×48	25.60
-23	B-TEE	21	.040×4.7×50	32.0	↓	.040×4.7×48	30.60
-25	B-TEE	7	.032×4.1×50	7.34		.032×4.1×48	7.04
-27	DOUB	1	.040×2.3×50	.74		.040×2.3×48	.71
-29	DOUB	18	.040×1.1×50	6.35		.040×1.1×48	6.10
-31	DOUB	6	.025×1.2×50	1.44		.025×1.2×48	1.38
-33	DOUB	1	.160×2.3×50	3.58		.160×2.3×48	3.44
-35	DOUB	1	.180×2.7×50	3.90		.180×2.6×48	3.74
-37	DOUB	1	.060×2.2×50	1.06	↓	.060×2.2×48	1.01
-39	DOUB	1	.060×2.6×50	1.25	6AL4V STA	.060×2.6×48	1.20
	ADH.	✓	(.007)	2.12	AF143	(.007)	2.02
						TOT	82.84

-9 LOWER PANEL ASSY PARTS

DASH NO	NAME	NO REQ	RAW STOCK SIZE	RAW STOCK WT	MATL	FINISHED PART SIZE	FIN. WT LBS
-41	SKIN	1	.050×13.0×60	6.84	8-8-2-3	.050×13.0×48	5.47
-43	SKIN	1	.050×13.1×60	6.89	↓	.050×13.1×48	5.51
-45	SKIN	1	.050×13.6×60	7.15		.050×13.6×48	6.73
-47	SKIN	1	.032×14.1×60	4.74		.032×14.1×48	3.80
-49	B-TEE	21	.032×4.3×50	25.20		.032×4.3×48	24.20
-51	B-TEE	7	.025×4.0×50	6.12		.025×4.0×48	5.86
-53	DOUB	1	.15×1.5×50	1.97		.15×1.5×48	1.70
-55	DOUB	18	.040×1.1×50	6.93		.040×1.1×48	6.65
-57	DOUB	4	.190×1.6×50	10.10		.180×1.60×48	9.56
-59	DOUB	2	.180×1.7×50	5.36		.180×1.7×48	2.58
-61	CAP	1	EXTR×.6×50	5.25		EXTR×.21 in²×48	1.77
-63	CAP	1	EXTR×.6×50	5.25		EXTR×.27 in²×48	2.26
-65	CAP	1	EXTR×.8×50	7.00		EXTR .27 in²×48	2.26
-67	CAP	1	EXTR×.8×50	7.00		EXTR×.27 in²×48	2.26
-69	CAP	1	EXTR×.6×50	5.25		EXTR×.21×48	1.77
-71	INTERC.	72	.040×2.5×2.5	3.15	↓	.040×3 in²	1.51
-73	INTERC.	24	.040×2.5×2.6	1.06	8-8-2-3	.040×3.1 in²	.55
	ADH.	✓	(.007)	2.23	AF143	(.007)	2.09
						TOT.	84.48

-11 FRONT SPAR ASSY PARTS

DASH NO	NAME	NO REQ	RAW STOCK SIZE	RAW STOCK WT	MATL	FINISHED PART SIZE	FIN. WT LBS
-75	CAP	1	EXTR×1.0×50	8.75	8-8-2-3	EXTR .53 in²×48	4.46
-77	WEB	1	.016×4×50	.56	↓	.016×3.8×48	.51
-79	WEB	1	.100×7×50	6.14	8-8-2-3	.100×6.75×48	3.19
-81	CORE	1	.5×5.5×50	.35	4.5 #/ft³ AL	.50×4.0×48	.25
-91	EDGE	2	.020×2.0×49	.69	8-8-2-3	.020×2.0×48	.68
-117	TEE	4	EXTR×.5 in²×3.7	1.23	8-8-2-3	EXTR×.38 in²×3.7	.22
-	ADH	✓	(.007)	.25	AF143	(.007)	.22
						TOT	9.53

-13 FRONT AUX. SPAR ASSY PARTS

DASH NO	NAME	NO REQ	RAW STOCK SIZE	RAW STOCK WT	MATL	FINISHED PART SIZE	FIN. WT LBS
-83	CAP	1	EXTR×.7 in²×50	6.12	8-8-2-3	EXTR×.30 in²×48	2.51
-85	WEB	1	.10×10×50	8.75	8-8-2-3	.10/.016×9.5×48	3.87
-87	WEB	1	.016×7×50	.98	8-8-2-3	.016×6.5×48	.96
-89	CORE	1	.50×8.5×50 (4.5#/ft³)	.54	4.5#/ft³ AL	.50×7.5×48	.40
-91	EDGE	2	.020×2×50	.69	8-8-2-3	.020×2×48	.68
-119	TEE	8	EXTR×.57×5.3	3.8	8-8-2-3	EXTR×.04 in²×5.3	.62
✓	AHD		.007	.37	AF143	.007	.35
						TOT	8.80

-15 CENTER SPAR ASSY PARTS

DASH NO	NAME	NO REQ	RAW STOCK SIZE	RAW STOCK WT	MATL	FINISHED PART SIZE	FIN. WT LBS
-93	CAP	1	EXTR×.70 in²×50	6.12	8-8-2-3	EXTR×.30 in²×48	2.52
-95	WEB	1	.016×7.5×50	1.05	8-8-2-3		1.03
-97	WEB	1	.10×10.6×50	9.30	8-8-2-3	.10/.016×10.6×48	3.83
-99	CORE	1	.50×9×50 (4.5#/ft³)	.57	4.5#/ft³ AL	.50×8.0×48	.43
-91	EDGE	2	.020×2×50	.69	8-8-2-3	.020×2×48	.68
-121	TEE	8	EXTR×.50 in²×5.8	4.15	8-8-2-3	EXTR×.04 in²×5.8	.68
✓	ADH			.39			.37
						TOT	9.54

-17 AFT AUX. SPAR ASSY PARTS

DASH NO	NAME	NO REQ	RAW STOCK SIZE	RAW STOCK WT	MATL	FINISHED PART SIZE	FIN. WT LBS
-101	CAP	1	EXTR×.70 in²×50	6.12	8-8-2-3	EXTR×.20 in²×48	1.68
-103	WEB	1	.016×7.0×50	.98	8-8-2-3	.016×7.0×48	.96
-105	WEB	1	.10×10.2×50	8.92	8-8-2-3	.10/.016×10.2×48	3.75
-107	CORE	1	.50×8.6×50	.55	4.5#/ft³ AL	.50×7.7×48	.42
-91	EDGE	2	.020×2×50	.69	8-8-2-3	.020×2×48	.68
-123	TEE	8	EXTR×.50 in²×5.3	3.80	8-8-2-3	EXTR×.04 in²×5.3	.62
-	ADH	✓	.007	.38	AF143	.007	.36
						TOT.	8.47

-19 REAR SPAR ASSY PARTS

DASH NO	NAME	NO REQ	RAW STOCK SIZE	RAW STOCK WT	MATL	FINISHED PART SIZE	FIN. WT LBS
-109	CAP	1	EXTR×1.0 in²×50	8.75		EXTR×.52 in²×48	4.38
-111	WEB	1	.016×5.5×50	.78		.016×5.5×48	.75
-113	WEB	1	.10×8.9×50	7.80		.10/.016×8.9×48	3.81
-115	CORE	1	.50×7.6×50	.49	4.5#/ft³ AL	.50×6.5×48	.40
-91	EDGE	2	.020×2×50	.69		.020×2×48	.68
-125	TEE	4	EXTR×.50 in²×5.4	3.90		EXTR×.04 in²×5.4	.32
✓	ADH.		(.007)	.32	AF143	.007	.30
							10.64

TABLE II

-127 BHD ASSY PARTS

DASH NO.	NAME	NO REQD	RAW STOCK SIZE	RAW STOCK WT.	MATL.	FINISHED PART SIZE	FIN. WT. LBS.
-135	WEB	2	.016×13×9	.60	6AL4V ANN	.016×12.5×7.5	.48
-137	CORE	1	.25×13×9	.12	4.5#/ft³ AL	.25×11.5×6.5	.10
-	P.COMPOUND		—	.33	EPOXY/GLASS	—	.27
✓	ADH.	✓	(.007)	.25	AF143	(.007)	.21
							1.06

-129 BHD ASSY PARTS

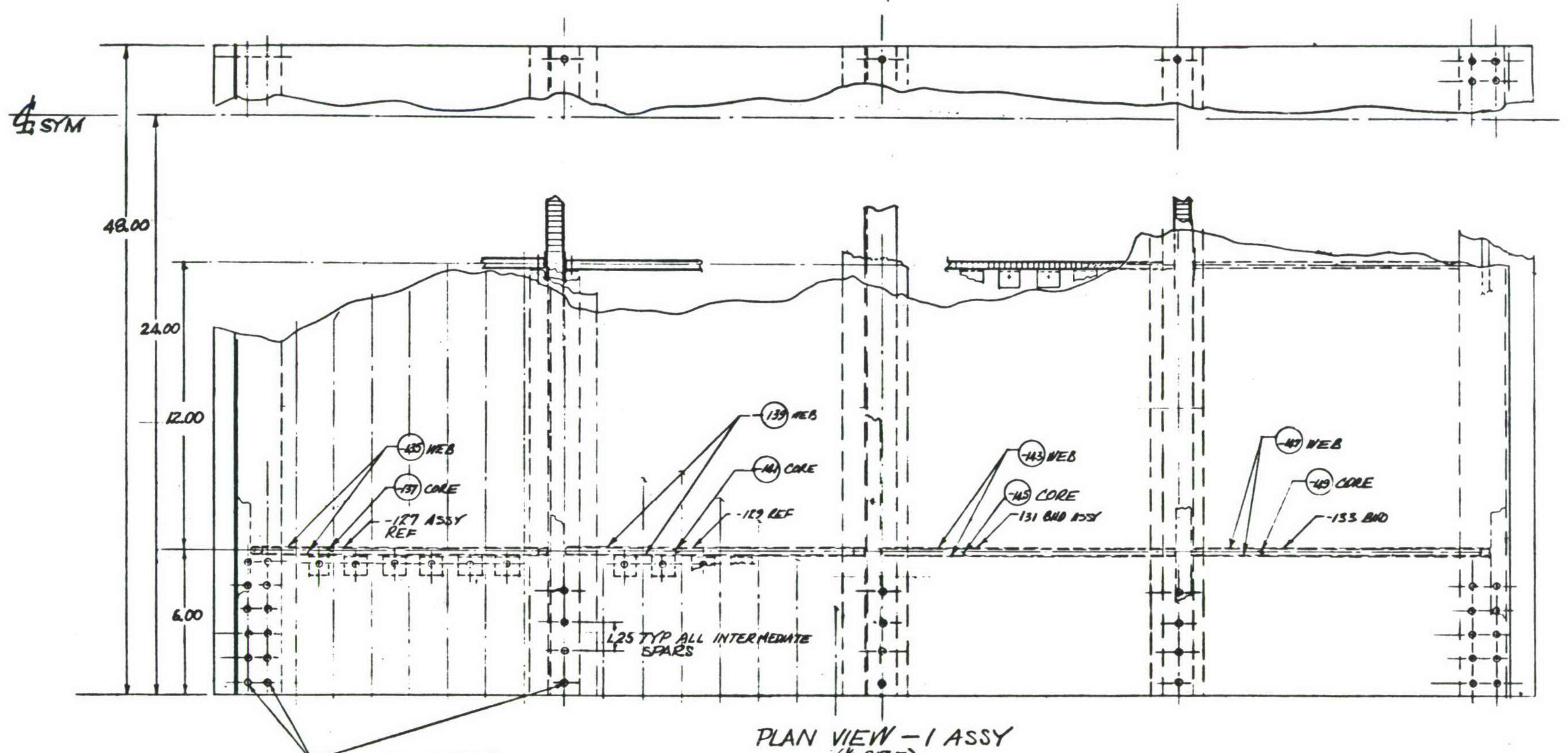
DASH NO.	NAME	NO REQD	RAW STOCK SIZE	RAW STOCK WT.	MATL.	FINISHED PART SIZE	FIN. WT. LBS.
-139	WEB	2	.016×13×10	.67	6AL4V	.016×12.5×9	.58
-141	CORE	1	.25×13×10	.13	4.5#/ft³ AL	.25×11.5×8.0	.11
	P.COMPOUND			.37	EPOXY/GLASS	—	.31
	ADH.	✓	.007	.29	AF143	.007	.25
							1.25

-131 BHD ASSY PARTS

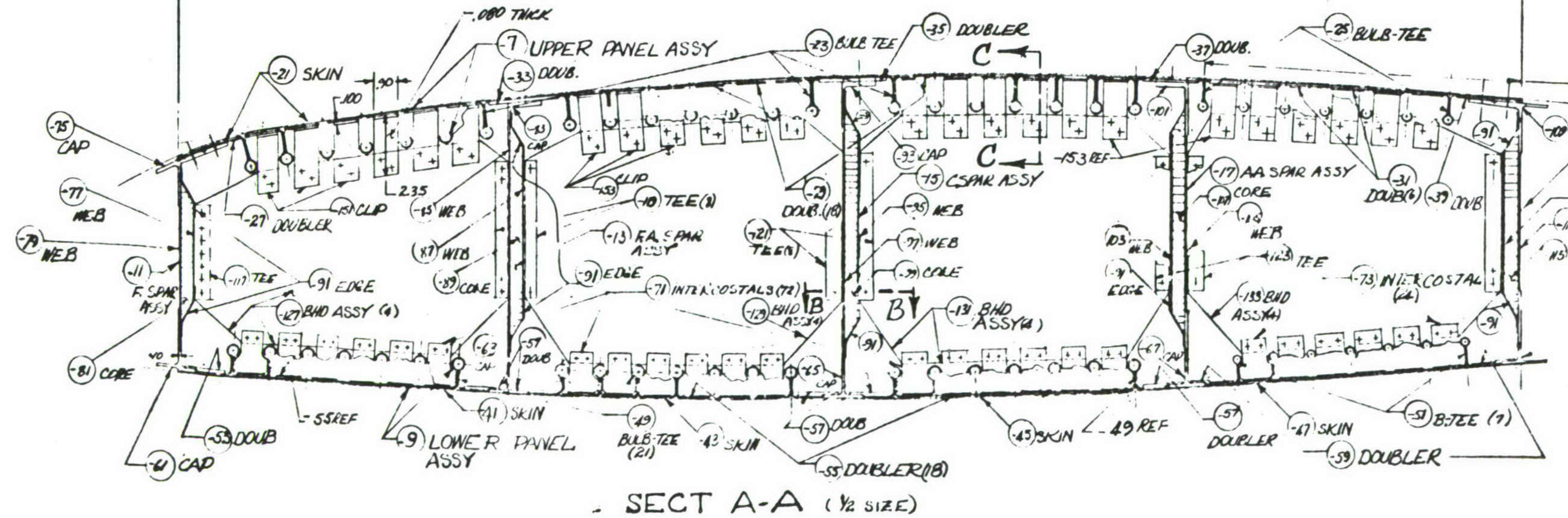
DASH NO.	NAME	NO REQD	RAW STOCK SIZE	RAW STOCK WT.	MATL.	FINISHED PART SIZE	FIN. WT. LBS.
-143	WEB	2	.016×13×10	.67	8-8-2-3	.016×12.3×8.0	.57
-145	CORE	1	.25×13×10	.13	4.5#/ft³ AL	.25×11.3×8.0	.11
-	P.COMPOUND		—	.37	EPOXY/GLASS	—	.31
-	ADH.	-	(.007)	.29	AF143	(.007)	.25
							1.24

-133 BHD ASSY PARTS

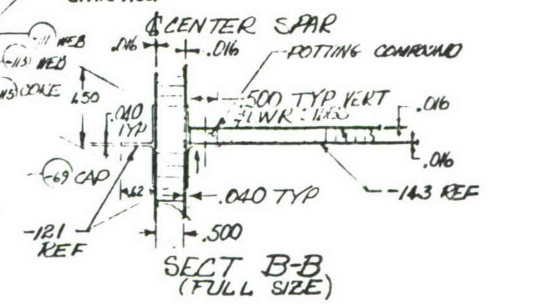
DASH NO.	NAME	NO REQD	RAW STOCK SIZE	RAW STOCK WT.	MATL.	FINISHED PART SIZE	FIN. WT. LBS.
-147	WEB	2	.016×13×10	.67		.016×12.3×8.8	.57
-149	CORE	1	.25×13×10	.12		.25×11.3×8.8	.10
✓	P.COMPOUND		—	.34	EPOXY/GLASS	—	.28
✓	ADH.	✓	(.007)	.26	AF143	(.007)	.22
							1.17



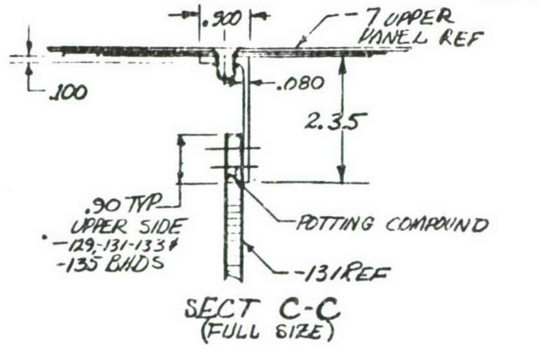
PLAN VIEW - 1 ASSY (½ SIZE)



SECT A-A (½ SIZE)



SECT B-B (FULL SIZE)



SECT C-C (FULL SIZE)

NOTES:

1. VALUE ASSUMED PENDING TEST RESULTS

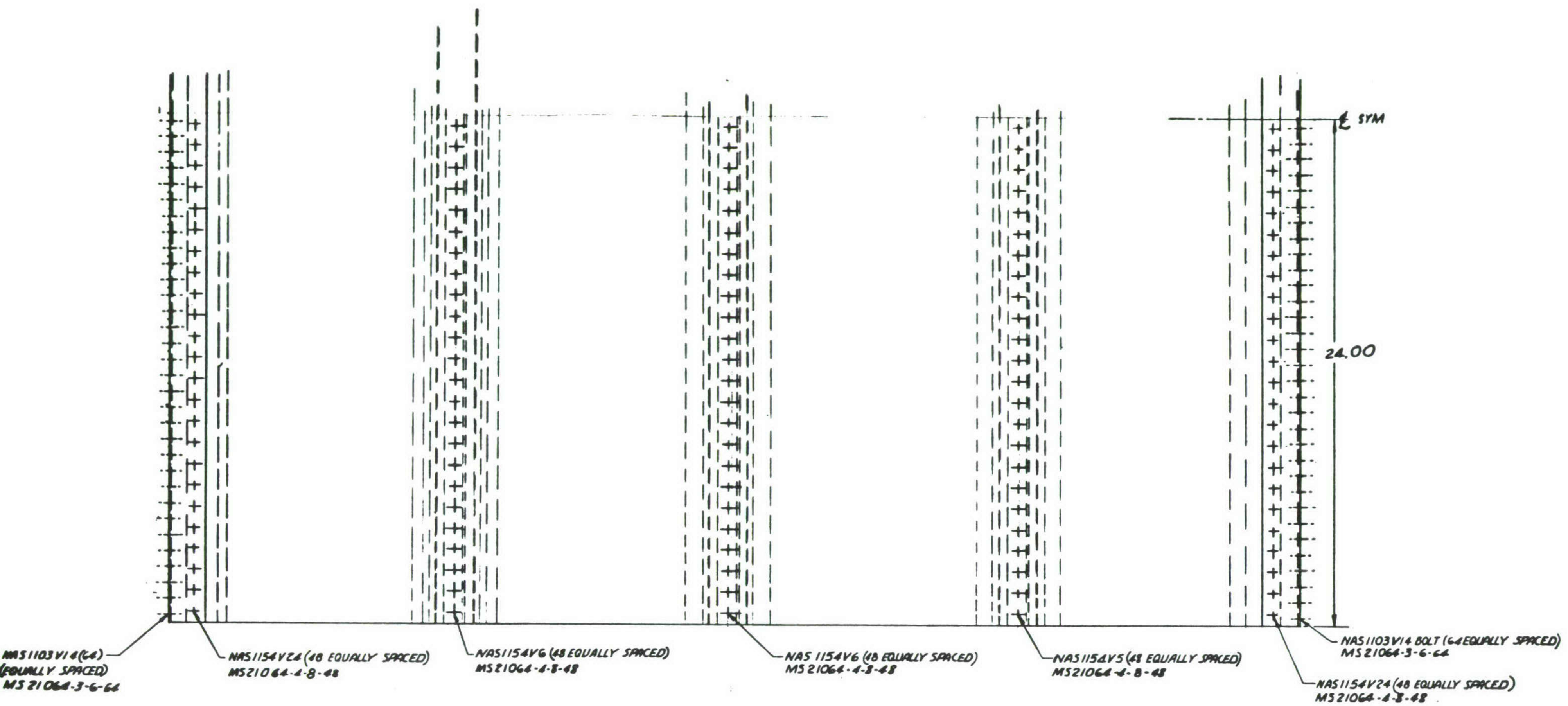
PRELIMINARY DESIGN DRAWING

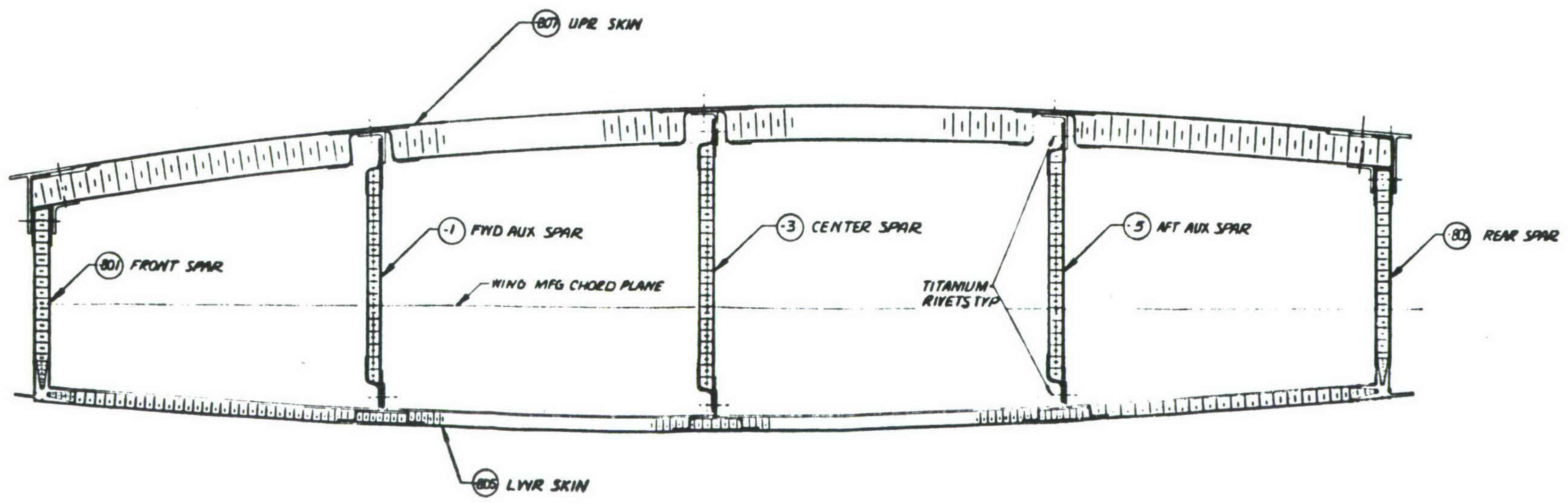
ANALYTICAL ASSY ~ BULBED-TEE STIFFENED SKIN (CCC 140.0)

GENERAL DYNAMICS
Convair Aerospace Division

610RA011

339/340





CROSS SECTION -809 ANALYTICAL ASSY

ANALYTICAL ASSY CONCEPT DATA SUMMARY — 610RA012C

DASH NO.	PART NAME	NO REQD	RAW STOCK SIZE	RAW STOCK WT	MATL	MATL PROPS APPLICABLE TO CRIT STRESS	STATIC LIMIT DES STRESS (F = 15.5/13.3)	MAX OPERATING STRESS	K_T	ALLOW FATIGUE STRESS	FRACT TOUGHNESS K_c KSI√IN	K_{ISCC}	DAM. TOL CLASS	INSPECTABILITY CLASS	CRIT CRACK LENGTH / TYPE	MIN NDI DETECT CRACK LENGTH / METH	ALLOW FRACT. STRESS	FINISHED WT LBS	COST DOLLARS
-1	FWD AUX SPAR	1		(13.615)		F_{tu} = 175 KSI	F = [illegible] (72.8)	72.5 KSI	3.0	≥72.5 KSI						.100/PEN, UT		(8.274)	328.60
-7	WEB	1	.017×11×50	1.636	Ti-8-8-2-3													1.492	
-9	WEB	1	.017×9×50	1.339	Ti-8823													1.142	
-11	CORE	1	.500×9×48	.563	5056-.45													.519	
-13	DOUBLER	2	.040×16×48	1.076	Ti-8-8-2-3													1.048	
-15	CLOSURE	2	.040×3×49	2.058	Ti-88-2-3													1.680	
-17	CLIP		1/2×1 1/2×49	12.25	Ti 6Al-4V													1.654	
-19	ADHESIVE		.02×11×49	.755	AF143													.739	
-3	CENTER SPAR			(20.104)												.100/PEN, UT		(9.463)	337.79
-27	WEB		.017×12×50	1.785	Ti-8-8-2-3													1.656	
-29	WEB		.017×10×50	1.488	Ti-8-8-2-3													1.311	
-31	CORE		.500×10×48	.625	5056-.45													.389	
-13	DOUBLER		.040×16×48	1.075	Ti-8-8-2-3													1.048	
-15	CLOSURE		.040×3×48	2.035	Ti-8-8-2-3													1.680	
-33	CLIP		1/16×1 1/16×49	12.250	Ti-6Al-4V													2.313	
-19	ADHESIVE		.02×12×49	.823	AF143													.806	
-5	AFT AUX SPAR			(20.104)												.100/PEN, UT		(8.819)	337.77
-47	WEB	1	.017×12×50	1.785	Ti-8-8-2-3													1.589	
-49	WEB	1	.017×10×50	1.488	Ti-8-8-2-3													1.248	
-51	CORE	1	.500×10×48	.625	5056-.45													.563	
-13	DOUBLER	2	.040×16×48	1.075	Ti-8-8-2-3													1.048	
-15	CLOSURE	2	.040×3×48	2.058	Ti-8-8-2-3													1.68	
-53	CLIP	1	1/16×1/4×49	12.25	Ti-6Al-4V													1.385	
-19	ADHESIVE	1	.02×12×49	.823	AF143													.806	
-801	FRONT SPAR			(24.714)		F_{tu} = 175 KSI										.100/PEN, UT		(9.723)	317.84
-67	WEB	1	.017×10×50	1.488	Ti-8-8-2-3													1.235	
-69	WEB	1	.017×10×50	1.488	Ti-8-8-2-3													1.164	
-71	CORE	1	.500×8×48	.5	5056-.45													.463	
-65	CLOSURE	1	.040×3×50	.42	Ti-8-8-2-3													.336	
-73	EXTRUSION	1	7(1.9×1.2)×52	19.110	Ti-6Al-4V													4.870	
-63	DOUBLER	2	.05×13×48	1.091	Ti-8-8-2-3													1.050	
-19	ADHESIVE	1	.02×9×49	.617	AF143													.605	
-803	REAR SPAR			(24.93)												.100/PEN, UT		(10.489)	305.64
-87	WEB	1	.017×10×50	1.488	Ti-8-8-2-3													1.357	
-89	WEB	1	.017×11×50	1.636	Ti-88-2-3													1.457	
-91	CORE	1	.500×9×48	.563	5056-.45													.550	
-93	DOUBLER	2	.040×15×48	1.008	Ti-88-2-3													1.008	
-99	EXTRUSION	1	7×(1.2×1.0)×52	19.110	Ti-8-8-2-3													5.210	
-97	CLOSURE	1	.03×2.5×49	.757	GRP													.252	
-19	ADHESIVE	1	.02×9.75×49	.669	AF143													.655	
-805	LWR SKIN			(103.308)		F_{tu} = 175	F = 117 (92.5)	92.5	1.0	792.5 SEE NOTE 1	80		F.S.	DEPOT	.395 SURFACE	.100/PEN, UT	102.5 KSI	(80.822)	1980.18
-55	WELD ASSY	1		(4.013)														(2.981)	
-23	INSERT	1	.06×5×49	2.701	Ti-8-8-2-3													2.074	
-77	TAB	1	.09×1.2×49	1.312	"													.907	
-57	WELD ASSY	1		(4.013)														(2.981)	
-23	INSERT	1	.06×5×49	2.701	Ti-8-8-2-3													2.074	
-77	TAB	1	.09×1.2×49	1.312	"													.907	
-59	WELD ASSY			(4.013)														(2.981)	
-23	INSERT	1	.06×5×49	2.701	Ti-8-8-2-3													2.074	
-77	TAB	1	.09×1.2×49	1.312	"													.907	
-59	DOUBLER	1	.04×2.3×48	.773	"													.756	
-37	INNER SKIN	1	.08×14.6×52	10.629	Ti-8-8-2-3													8.468	
-39		1	.08×15×	10.920														8.669	
-41		1	.08×15.4×	11.211														9.005	
-43	INNER	1	.032×14×	4.077														3.226	
-79	OUTER	1	.08×15.4×	11.211														9.005	
-81		1	.08×15×	10.920														8.837	
-83		1	.08×16×	11.648														9.206	
-85	OUTER SKIN	1	.032×15×	4.368														3.427	
-21	DOUBLER	1	.08×3.5×	2.352														2.352	
-61		1	.08×3.5×	2.352														2.352	
-75	DOUBLER	1	.08×3.5×	2.352	Ti-8-8-2-3													2.352	
-131	CORE	1	.36×2×48	.136	5056													.136	
-133		1	.36×2×	.136														.136	
-135		1	.36×2×	.136														.136	
-137		1	.5×11.2×	.949														.949	
-139		1	.5×11×	.932														.932	
-141		1	.5×11.5×	.974														.974	
-143	CORE	1	.5×10.6×48	.961	5056													.961	
-807	UPPER SKIN				Ti-6Al-4V	F_{ty} = 154	F = 103.9 (81.8)	81.5	—							.100/PEN, UT	—	(96.3[illegible])	2800.63
-101	OUTER SKIN	1	.08×63×60	48.384														31.027	
-103	INNER	1	×11×52	7.322														7.465	
-105		1	×12	7.987														6.758	
-107		1	.08×13	8.653														7.066	
-109	INNER SKIN	1	.04×14	4.659														3.732	
-111	CLOSURE	3	.04×23×52	7.300														5.805	
-113	CLIP FS	1	.75×2.5×49	7.840														3.145	
-115	FS	1	1 1/16×1 1/16×49	12.250														1.536	
-117	RS	1	2×3×49	47.040														3.226	
-119	CLIP RS	1	1 1/16×1 1/16×49	12.250														1.536	
-25	DOUBLER	1	.1×2×48	1.536														1.352	
-35	DOUBLER	1	.1×5×48	3.840														3.533	
-45	DOUBLER	1	.1×4×48	3.072														2.688	
-121	DOUBLER	1	.125×4×49	3.920	Ti-6Al-4V													2.208	
-123	CORE	1	.125×24×48	1.937	5056													1.937	
-125		1	115	1.797														1.797	
-127		1	119	1.859														1.859	
-129	CORE	1	.125×12.4×48	2.061	5056													2.061	
-145	DOUBLER	1	.125×4×49	3.92	Ti-6Al-4V													2.563	
-147	CLOSURE	1	.04×2.3×49	.316	GRP													.691	
-149	CLOSURE	1	.04×2.3×49	.316	GRP													.691	
-151	DOUBLER	1		.784	Ti-6Al-4V													.750	
-19	ADHESIVE		.02×56×48	3.927	AF143													3.427	
-809	ANALYTICAL ASSY																	(224.38)	
	FRONT SPAR ATTACHMENTS			5.76														5.76	
	INTER. SPARS ATTACHMENTS			4.02														4.02	634.42
	REAR SPAR ATTACHMENTS			5.76														5.76	
																	TOTAL	239.72	7043.07

NOTES:

1. VALUE ASSUMED PENDING TEST RESULTS

SYM	ZONE	REVISIONS DESCRIPTION	DATE	APPROVED
A		CHANGED -138 -99 TO EXTRUSION; DELETED -95, -153, -155, & -157	1-30-73	[signature]
B		ADDED TABS TO FRONT AND REAR SPARS	1/30/73	[signature]
C		CHANGED WTS ON -41 & TOTAL	1/30/73	[signature]

PRELIMINARY DESIGN DRAWING

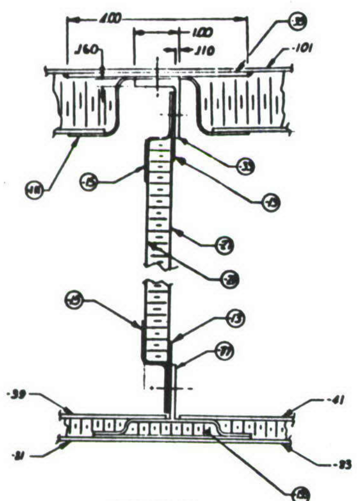
ANALYTICAL ASSY - ADHESIVE BONDED HONEYCOMB SANDWICH SKINS & SPAR WEBS, CSS 140

BY J. Holland | APPROVED | SCALE 1/2 NOTED | DATE 1-12-73

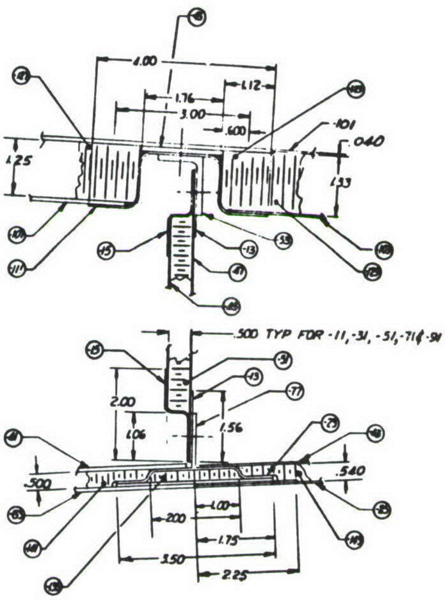
GENERAL DYNAMICS
Convair Aerospace Division
Fort Worth Operation

610RA012C

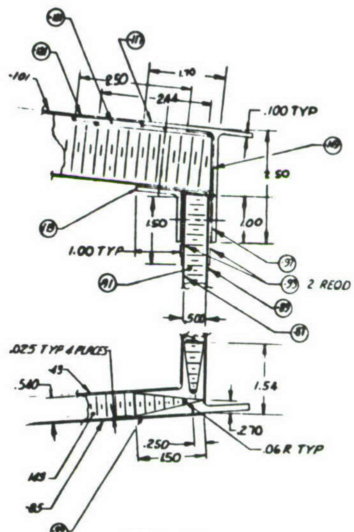
SHEET 1 OF 1



DETAIL -3
CENTER SPAR

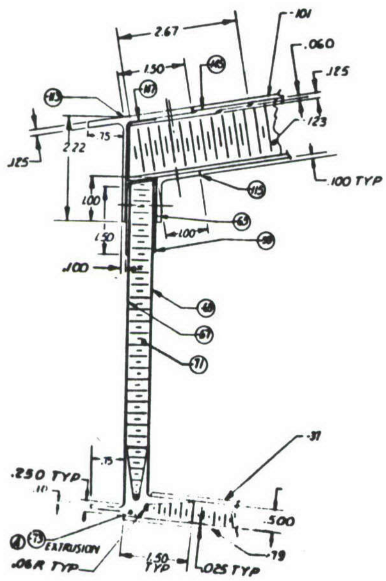


DETAIL -5
AFT AUX SPAR

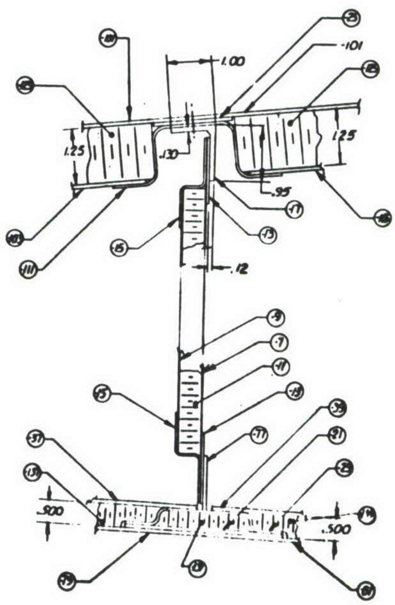


EXTRUSION
Ⓐ

DETAIL -803
REAR SPAR



DETAIL -801
FRONT SPAR



DETAIL -1
FWD AUX SPAR

Sheet 2

-1 ANALYTICAL ASSY~ CONCEPT DATA SUMMARY																		GIORA013 'A'	
DASH NO.	PART NAME	NO. REQ'D	RAW STOCK SIZE	RAW STOCK WEIGHT	MAT'L	MAT'L PROP'S APPLICABLE TO CRIT. STRESS	STATIC LIMIT DES STRESS (F x 1.5/1.5)	MAX OPERATING STRESS	KT	ALLOW FATIGUE STRESS	FRACT TOUGH	K_{ISCC}	DAM TOL CLASS	INSPECT-ABILITY CLASS	CRIT. CRACK LENGTH TYP	MIN NDI DETECT CRACK LENGTH - METH.	ALLOW FRACT STRESS	FINISHED WEIGHT IN LBS.	COST IN DOLLARS
-3	SKIN PANEL ASSY	1														.15/UT		113.12	987.65
	ADESIVE SEE NOTE 3																		
	SEE TABLE II FOR ALL DETAILS																		
-5	BEAM ASSY	1														.10/PEN		7.76	221.52
-7	↑	1																9.25	274.70
-9		1																10.37	281.06
-11	↓	1																10.13	203.45
-13	BEAM ASSY	1																8.13	263.24
		SEE TABLE III FOR ALL DETAILS																	
-15	SKIN ASSY	1																21.84	319.31
-17	↑	1																21.92	315.88
-19	↓	1																23.61	321.18
-21	SKIN ASSY	1																13.17	293.04
			SEE TABLE IV																
-63	SPAR CAP SAME AS GIORA003-55	1	EXTR x 54	3.41	AL													2.17	12.51
-65	SPAR CAP SAME AS GIORA003-57	1	EXTR x 54	3.73	AL													2.45	13.11
-67	SPAR CAP SAME AS GIORA003-59	1	EXTR x 54	3.41	AL													2.17	12.51
-121	SPAR CAP	1	EXTR x 54	3.24	AL													2.88	12.20
C387V4-8	BOLT	78			TI													.56	42.68
C387V4-7	BOLT	78			TI													.49	25.74
C387V5-19	BOLT	111			TI													2.28	71.04
C520-428-3	NUT	78			STL													.56	30.42
C520-428-4	NUT	78			STL													.49	81.20
C520-524-3	NUT	111			STL													2.28	54.89
C556-4	INJ. FTG	8			TI													.03	7.02
C556-3	INJ. FTG	24			TI													.09	28.76
NAS1528-4	PIN	322			AL													.65	60.86
NAS 1080D8	COLLAR	322			AL													.65	6.44
							(CONTINUED)												
																SUB TOTAL WT		257.05	8312.36 (SEE TABLE)

TABLE II
-3 SKIN PANEL ASSY

DASH NO.	PART NAME	RAW STOCK SIZE	RAW STOCK WT	MATERIAL	FINISHED STOCK SIZE	FINISHED WT IN LBS
-23 SAME AS GIORA003-79	OUTER SKIN	.125 x 54 x 60	40.5	7050-T76 AL	.125 x 48.0 x 53	29.61
-25 SAME AS GIORA003-81	INNER SKIN	.125 x 54 x 55	37.13	7050-T76-AL	.125 x 48.0 x 48.5	27.71
-27 SAME AS GIORA003-61	EDGE MEMBER	1.0 x 3.6 x 54	19.44	7050-T73-AL	-	8.28
-29 SAME AS GIORA003-63	EDGE MEMBER	1.0 x 4.6 x 54	24.84	7050-T73-AL	-	9.64
-31 SAME AS GIORA003-65	SLUG	1.0 x 6.1 x 54	32.94	7050-T73-AL	—	17.16
-33 SAME AS GIORA003-67	SLUG	1.0 x 5.3 x 54	28.62	7050-T73-AL	—	14.10
-35 SAME AS GIORA003-69	SLUG	1.0 x 5.6 x 54	30.24	7050-T73-AL	—	15.40
-37 SAME AS GIORA003-71	CORE	1.0 x 9.0 x 54		P006-1B AL CORE (FMS-1070A) 4.5 LBS/FT³	.750 x 8.75 x 48	.82
-39 SAME AS GIORA003-73	CORE	1.0 x 9.2 x 54			.750 x 9.02 x 48	.86
-41 SAME AS GIORA003-75	CORE	1.0 x 8.4 x 54			.750 x 8.21 x 48	.77
-43 SAME AS GIORA003-77	CORE	1.0 x 9.3 x 54			.785 x 9.17 x 48	.90
					TOTAL WT	113.12

TABLE III

BEAM ASSY NO	DASH NO	PART NAME	RAW STOCK SIZE	RAW STOCK WT	MATERIAL	FINISHED STOCK SIZE	FINISHED WT IN LBS	QUANTITY	TOTAL WT IN LBS	TOTAL WT PER ASSY
-5	-43	BEAM	.125 x 8.6 x 49	9.17	6AL-4V ANNEALED	.125 x 7.62 x 48	3.82	1	3.390	7.56 + .20 = 7.76
	-45	STIFF	.080 x 1.37 x 7.15	.136	↕	.080 x .87 x 6.14	.062	24	1.360	
	-69	SPLICE PLATE	.375 x 2.63 x 49	7.725		.160 x 2.13 x 48	1.42	1	2.610	
-7	-47	BEAM	.125 x 11.4 x 49	12.22		.125 x 10.36 x 48	3.02	1	3.233	9.253
	-49	STIFF.	.050 x 1.46 x 11.20	.143		.050 x .96 x 10.19	.062	45	2.560	
	-71	SPLICE PLATE	.375 x 3.0 x 49	8.810		.180 x 2.50 x 48	1.05	1	3.460	
-9	-51	BEAM	.125 x 12.3 x 49	13.20		.125 x 11.29 x 48	3.20	1	3.411	10.371
	-53	STIFF.	.050 x 1.52 x 12.13	.161		.050 x 1.02 x 11.13	.089	43	3.500	
	-73	SPLICE PLATE	.375 x 3.0 x 49	8.810		.180 x 2.50 x 48	1.63	1	3.460	
-11	-55	BEAM	.125 x 11.86 x 49	11.79		.125 x 10.86 x 48	3.12	1	3.329	10.129
	-57	STIFF	.050 x 1.52 x 11.71	.155		.050 x 1.02 x 10.71	.085	43	3.340	
	-71	SPLICE PLATE	SEE ABOVE	1.28		SEE ABOVE	1.05	1	3.460	
-13	-59	BEAM	.125 x 11.01 x 49	11.74		.125 x 10.01 x 48	3.40	1	2.166	8.126
	-61	STIFF.	.050 x 1.55 x 9.05	1.23		.050 x 1.05 x 8.05	.065	39	2.330	
	-75	SPLICE PLATE	.375 x 2.6 x 49	7.625	6AL-4V ANNEALED	.160 x 2.10 x 48	.88	1	3.630	
-5	-135	STIFF	.080 x 1.50 x 7.15	.150	6AL-4V ANNEALED	.080 x 1.05 x 6.14	.075	3	.20	.20 (ADD TO -5)

TABLE IV

BEAM ASSY NO	DASH NO	PART NAME	RAW STOCK SIZE	RAW STOCK WT	MATERIAL	FINISHED STOCK SIZE	FINISHED WT IN LBS	QUANTITY	TOTAL WT IN LBS	TOTAL WT PER ASSY
-15	-77	SKIN	.312 x 3.20 x 49.	7.82	6AL-4V ANNEALED	.131 x 2.74 x 48	2.76	1	2.76	21.89
	-79	SKIN	.312 x 2.83 x 49.	6.95	6AL-4V ANNEALED	.140 x 2.45 x 48	2.62	1	2.62	
	-91	STIFF	.250 x 1.62 x 49.	3.17	6AL-4V ANNEALED	.178 x 1.12 x 48	1.53	2	3.06	
	-95	STIFF	.250 x 1.50 x 49.	2.94	6AL-4V ANNEALED	.178 x .97 x 48	1.33	6	7.95	
	-99	SKIN	.100 x 8.0 x 49.	6.87	6AL-4V ANNEALED	.094 x 7.45 x 48	5.45	1	5.45	
-17	-79	SKIN	.312 x 2.83 x 49	6.95	6AL-4V ANNEALED	.140 x 2.45 x 48	2.62	1	2.62	21.92
	-81	SKIN	.312 x 2.83 x 49	6.95	6AL-4V ANNEALED	.140 x 2.45 x 48	2.62	1	2.62	
	-91	STIFF	←		SEE ABOVE	→	1.53	2	3.06	
	-95	STIFF	←		SEE ABOVE	→	1.33	6	7.95	
	-101	SKIN	.100 x 8.30 x 49	6.51	6AL-4V ANNEALED	.094 x 7.75 x 48	5.67	1	5.67	
-19	-83	SKIN	.312 x 2.83 x 49	6.95	6AL-4V ANNEALED	.140 x 2.45 x 48	2.62	1	2.62	23.61
	-85	SKIN	.312 x 2.83 x 49	6.95	6AL-4V ANNEALED	.140 x 2.45 x 48	2.62	1	2.62	
	-91	STIFF	←		SEE ABOVE	→	1.53	2	3.06	
	-95	STIFF	←		SEE ABOVE	→	1.33	7	9.31	
	-103	SKIN	.100 x 8.90 x 49	6.98	6AL-4V ANNEALED	.094 x 8.30 x 48	6.00	1	6.00	
-21	-87	SKIN	.250 x 2.83 x 49	5.56	6AL-4V ANNEALED	.109 x 2.45 x 48	2.05	1	2.05	13.17
	-89	SKIN	.250 x 2.93 x 49	5.75	6AL-4V ANNEALED	.110 x 2.54 x 48	2.16	1	2.16	
	-93	STIFF	.250 x 1.34 x 49	2.63	6AL-4V ANNEALED	.130 x .84 x 48	.83	2	1.67	
	-97	STIFF	.250 x 1.25 x 49	2.45	6AL-4V ANNEALED	.130 x .73 x 48	.73	6	4.37	
	-105	SKIN	.100 x 8.50 x 49	6.66	6AL-4V ANNEALED	.048 x 7.90 x 48	2.92	1	2.92	

4. "A" CHG. - ADDED -121 SPAR CAP TO L/M AND REVISED WEIGHT TOTAL - WAS 257.05 TO 267.36 LBS.

3. USE AF 143 ADHESIVE (3M COMPANY) BETWEEN ALL EDGE MEMBERS, SLUGS, CORE, AND SKINS IN THE -3 ASSEMBLY.

2. THE FAYING SURFACES AT THE FRONT & REAR SPARS, AND ALL FASTENERS SHALL BE SEALED PER FPS-1004.

1. INSTALL C556 INJECTION FITTINGS PER MO76 EQUALLY SPACED BETWEEN FASTENERS AS SHOWN AND CENTERED ON THE SEALING GROOVE. PLUG WITH NAS 1081-06A3 SCREWS.

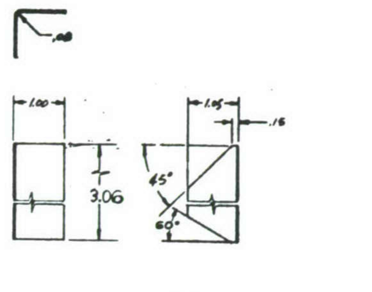
NOTES:

PRELIMINARY DESIGN DRAWING

ANALYTICAL ASSY- AL. HONEYCOMB SANDWICH UPPER PANEL - TI BLADE STIFFENED PLANK LOWER - [illegible] 6AL-4V ANNEALED	
SCALE 1/4	DATE 7-7-73
GENERAL DYNAMICS Convair Aerospace Division Fort Worth Operation	6IORA013A
	SHEET 1 OF

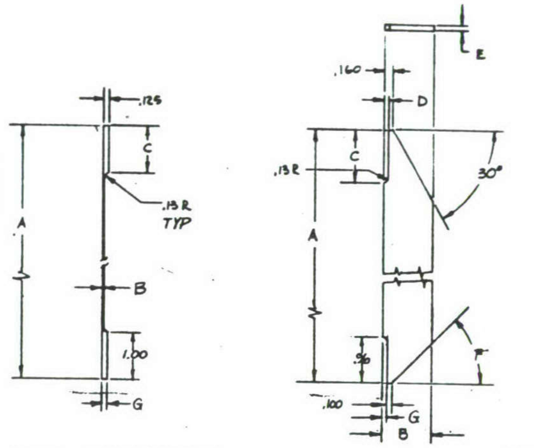
(CONTINUED)

-1 ANALYTICAL ASSEMBLY – CONCEPT DATA SUMMARY																			610RA004A
DASH NO.	PART NAME	NO. REQ'D	RAW STOCK SIZE	RAW STOCK WT.	MATL	MATL PROPS APPLICABLE TO CRITICAL STRESS	STATIC LIMIT DES STRESS (F_x 1.5 S/A_S)	MAX. OPERATING STRESS	K_T	ALLOW. FATIGUE STRESS	FRACT. TOUGH	K_{ISCC}	DAM TOL. CLASS	INSPECT-ABILITY CLASS	CRIT CRACK LENGTH TYPE	MIN. NDI DETECT CRACK LENGTH – METH.	ALLOW. FRACT. STRESS	FINISHED WEIGHT IN LBS.	COST IN DOLLARS
-123	STIFF	99	.050×2.9×2.7	6.37	6AL-4V ANNEALED													2.87	90.04
-125	BRACE	3	1.25×2.60×13.8	[illegible] 22.42	6AL-4V ANNEALED													1.11	231.93
-127	BRACE	3	1.25×2.50×13.9	[illegible] 22.80	6AL-4V ANNEALED													1.12	256.53
-129	BRACE	3	1.25×2.50×16.4	[illegible] 23.61	6AL-4V ANNEALED													1.16	260.25
-131	BRACE	3	1.25×2.60×16.0	[illegible] 22.95	6AL-4V ANNEALED													1.13	256.44
-133	CLIP	9	[illegible] 2.5		6AL-4V ANNEALED													.45	72.84
	MS20615-4M	198																1.668	3.96
	MS20615-6M	24																.804	.48
																	SUB TOTAL	10.31	1171.53
																	SUB TOTAL	257.05	3912.96
																	TOTAL	267.36	
-1 ASSY																			1676.53
																		TOTAL	6761.02



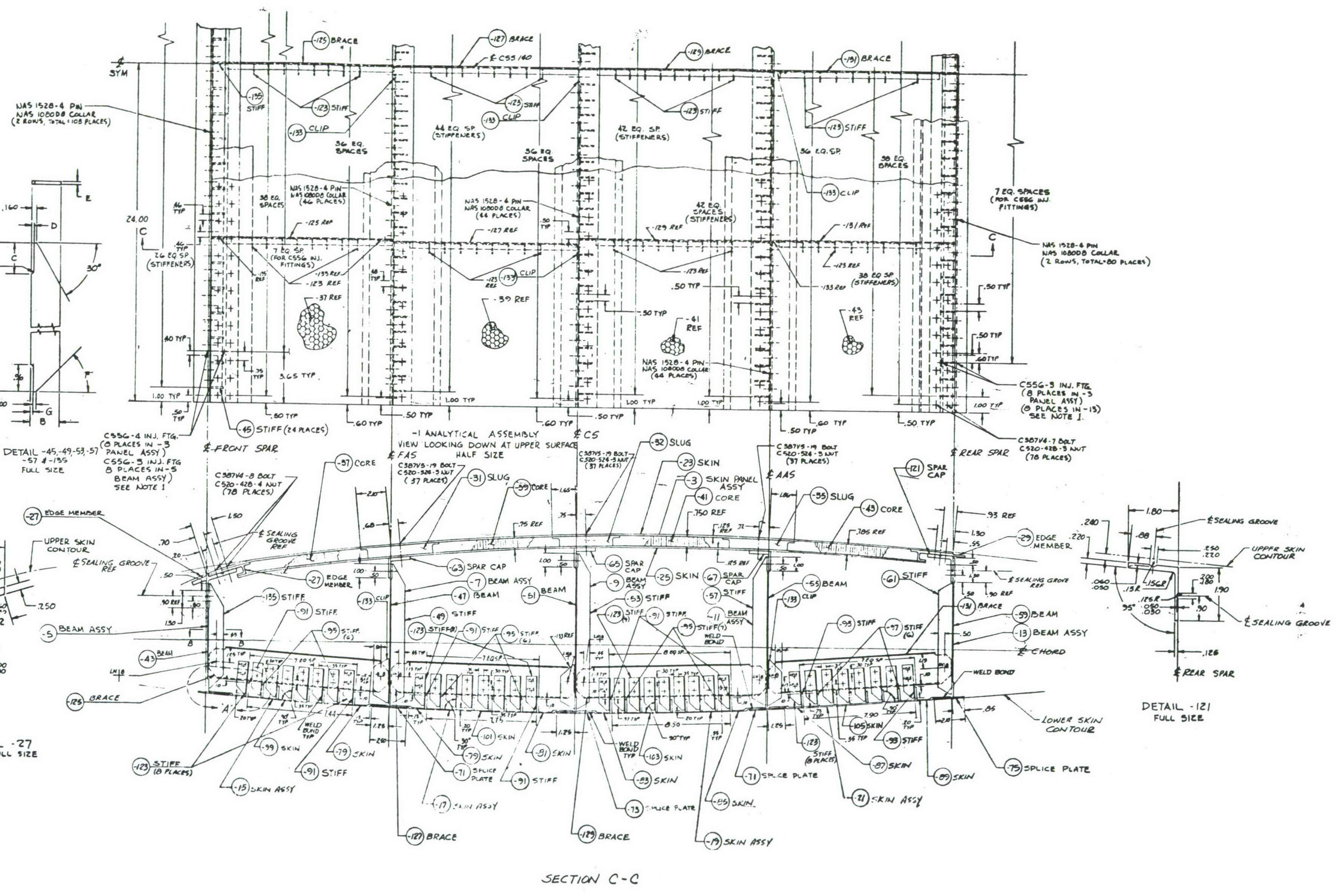
DETAIL -133
FULL SIZE

DASH NO	DIMENSION A	B	C	D	E	F	G
-43	7.63	.040	1.80				.080
-45	6.14	.87	1.95	.085	.080	45°	.080
-47	10.36	.025	1.00				.090
-49	10.19	.96	1.15	.100	.050	45°	.090
-51	11.29	.025	1.00				.090
-53	11.13	1.02	1.15	.100	.050	45°	.090
-55	10.86	.025	1.00				.090
-57	10.71	1.02	1.15	.100	.050	45°	.090
-59	10.01	.025	1.80				.080
-135	7.63	1.05	1.80	.055	.080	—	.080



DETAIL -43, -47, -51, -55, -59
FULL SIZE

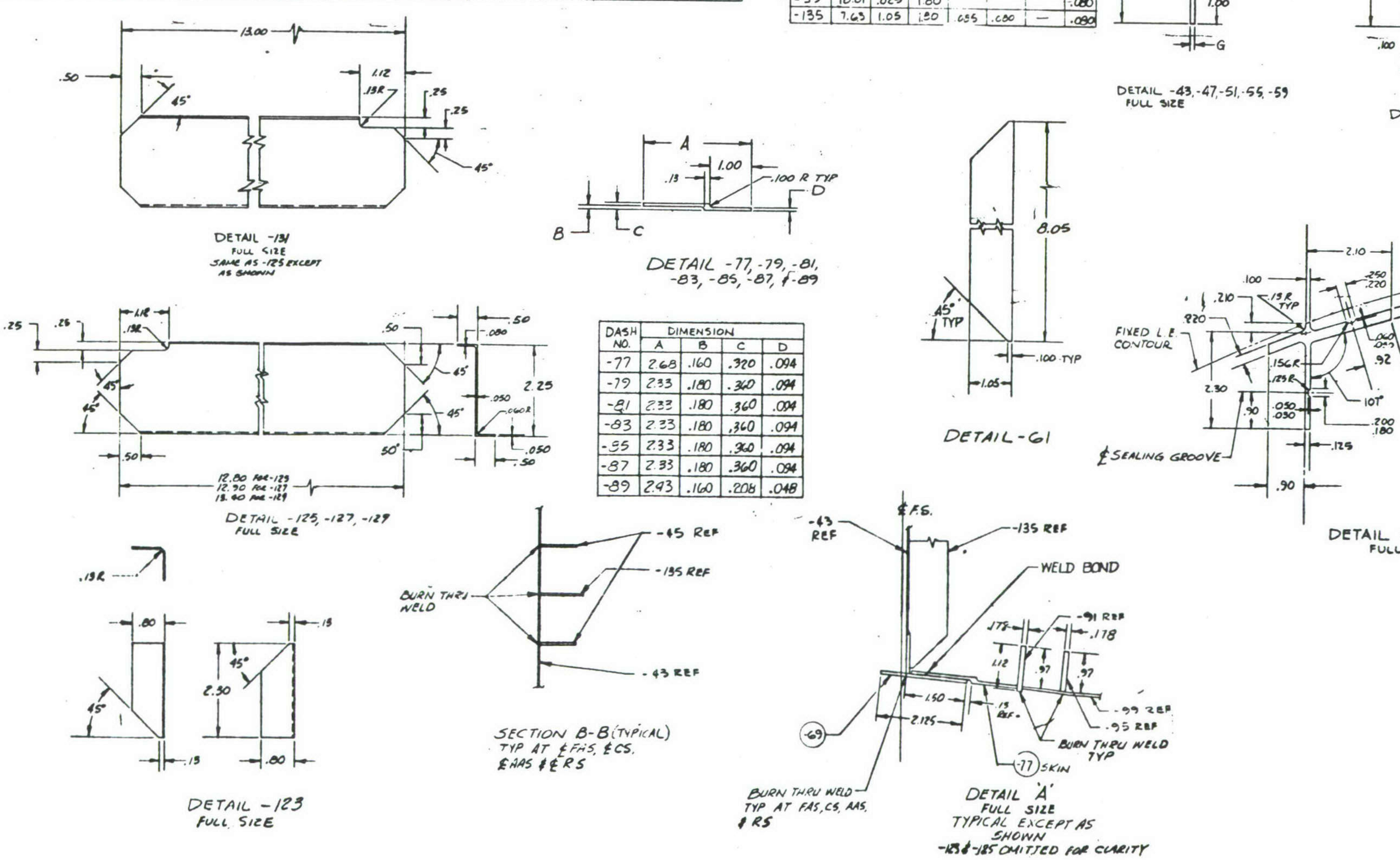
DETAIL -45, -49, -53, -57 & -135
FULL SIZE



-1 ANALYTICAL ASSEMBLY
VIEW LOOKING DOWN AT UPPER SURFACE
HALF SIZE

SECTION C-C

DETAIL -121
FULL SIZE



DETAIL -131
FULL SIZE
SAME AS -125 EXCEPT AS SHOWN

DETAIL -125, -127, -129
FULL SIZE

DETAIL -123
FULL SIZE

DETAIL -77, -79, -81, -83, -85, -87, & -89

DASH NO.	DIMENSION A	B	C	D
-77	2.68	.160	.320	.094
-79	2.33	.180	.360	.094
-81	2.33	.180	.360	.094
-83	2.33	.180	.360	.094
-85	2.33	.180	.360	.094
-87	2.33	.180	.360	.094
-89	2.43	.160	.208	.048

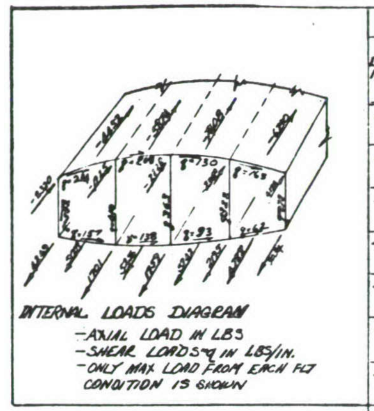
SECTION B-B (TYPICAL)
TYP AT ℄FAS, ℄CS, ℄AAS & ℄RS

DETAIL -61

DETAIL 'A'
FULL SIZE
TYPICAL EXCEPT AS SHOWN
-123 & -125 OMITTED FOR CLARITY

DETAIL -27
FULL SIZE

Sheet 2   347/348



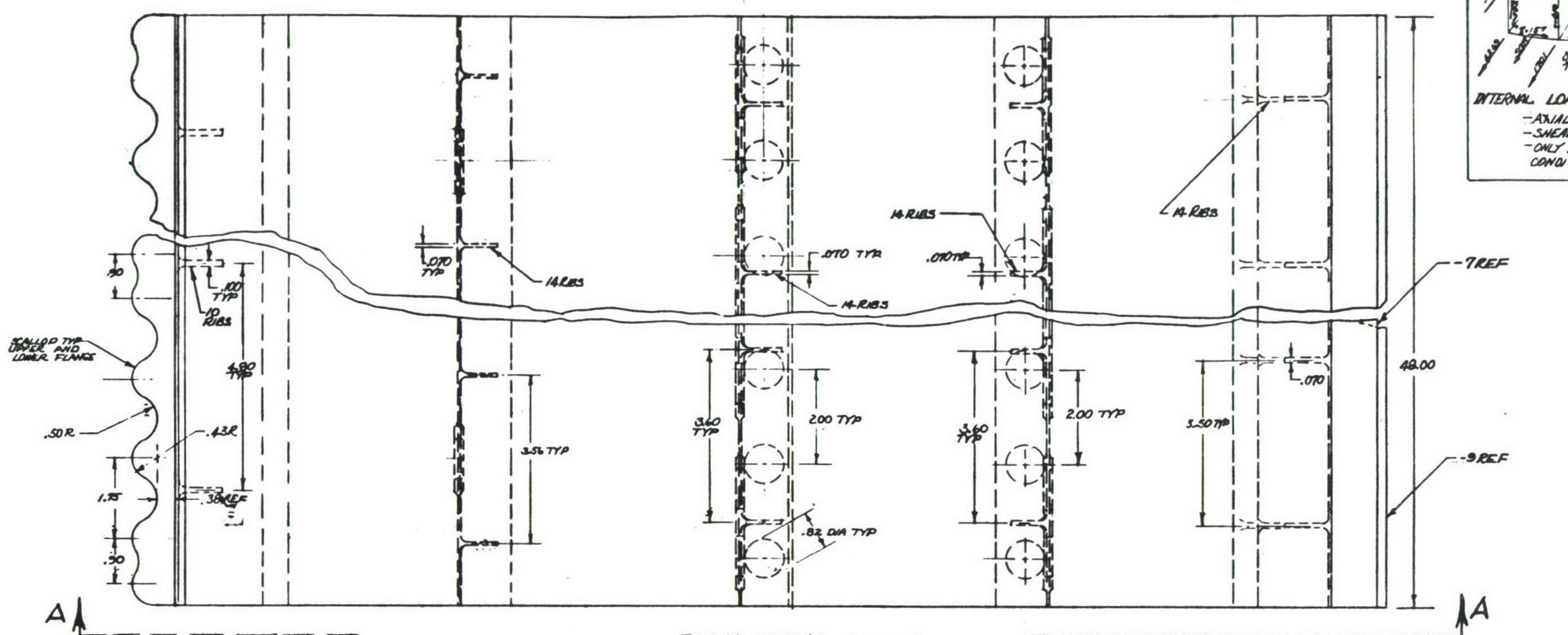
INTERNAL LOADS DIAGRAM
-AXIAL LOAD IN LBS
-SHEAR LOADS IN LBS/IN.
-ONLY MAX LOAD FROM EACH FLT CONDITION IS SHOWN

ANALYTICAL ASSY. ~ CONCEPT DATA SUMMARY 610RA-100

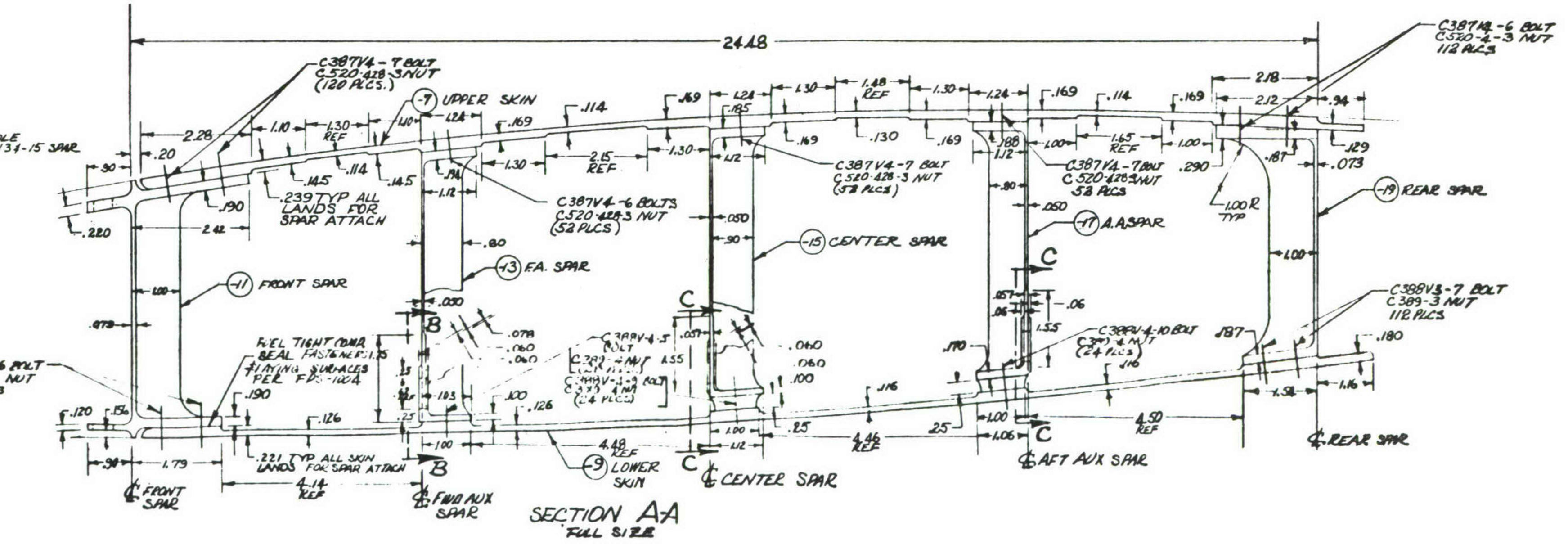
DASH NO	NAME	NO REQD	RAW STOCK SIZE	RAW STOCK WEIGHT LBS	MATL	MATL PROPERTIES	F ALLOW FOR CRIT. STRESS	TYPE STRESS / STRESS IMPACT	LIFE FACTORS K_T	ALLOW FATIGUE STRESS	K_{ISCC}	K_{IC}	MIN DETECT CRACK LENGTH	SAFE INITIAL CRACK LENGTH	CRITICAL CRACK LENGTH	ALLOW FRACT STRESS	FINISHED WEIGHT IN LBS	COST IN $ PER 1 ASSY
-7	UPPER SKIN	1	16x52x54	65.7	2024-T851 QQ-A-250/4	Ftu 68,000 Fty 61,000	Fy 61,000	ULT. Press. Ultimate 61,000	NOT CRITICAL @ CSS 340.0			26-28	NOT CRITICAL @ CSS340				20.69	186.73
-9	LOWER SKIN	1	36x52x54	65.7	2024-T851 FMS-1010	Ftu 68,000 Fty 61,000	Fy 61,000	ULT. Press. Ultimate 54,000									17.87	186.88
-11	FRONT SPAR	1	3.5x16.5x54	123.0		Ftu 63,000 Fty 57,000	Fy 57,000	ULT. Press Ultimate 8,725 psi									8.31	263.38
-13	FWD AUX SPAR	1	1.5x16.5x54	52.5		NOT CRITICAL											3.38	130.66
-15	CENTER SPAR	1	1.5x20x54	56.7													3.37	132.40
-17	AFT AUX SPAR	1	1.5x16.5x54	52.5													3.64	130.65
-19	REAR SPAR	1	2.5x16x54	81.0	2024-T851 FMS-1010												5.25	183.57
C387V4-7 BOLT		216															1.43	
C387V4-6 BOLT		164															1.03	
C388V3-6 BOLT		120															.313	
C388V3-7 BOLT		112															.372	
C388V4-5 BOLT		28															.144	45.40
C388V4-9 BOLT		24															.174	
C388V4-10 BOLT		24															.185	
C389-3 NUT		232															.610	
C389-4 NUT		76															.242	
C520-428-3 NUT		388															2.210	
-1 ASSY		1															.56	167.60
																TOOLING		166.83
																TOTALS	69.17	1896.01

QUALITATIVE CONCEPT PARAMETERS

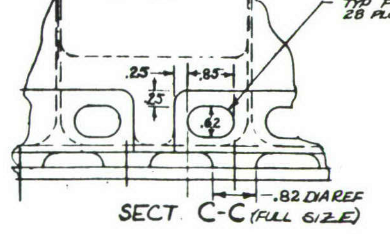
PARAMETER	SCORE
CONCEPT	50
MANUF. TECH	25
MATL TECH	40
FRACT. MECH'S.	10
FAT. QUAL.	75
SAFE CRACK	30
MULTIPLE LOAD PATH	30
INSPECTABILITY	80
ACCESSIBILITY	95
MANUFACTURABILITY	75
MAINTAINABILITY	70
REPAIRABILITY	65
PREDICTABILITY	95



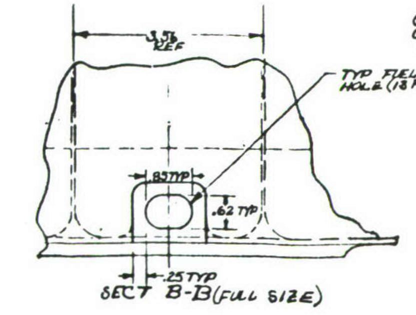
PLAN VIEW -1 ASSY
BASELINE ANALYTICAL ASSY
FULL SIZE



SECTION A-A
FULL SIZE



SECT C-C (FULL SIZE)



SECT B-B (FULL SIZE)

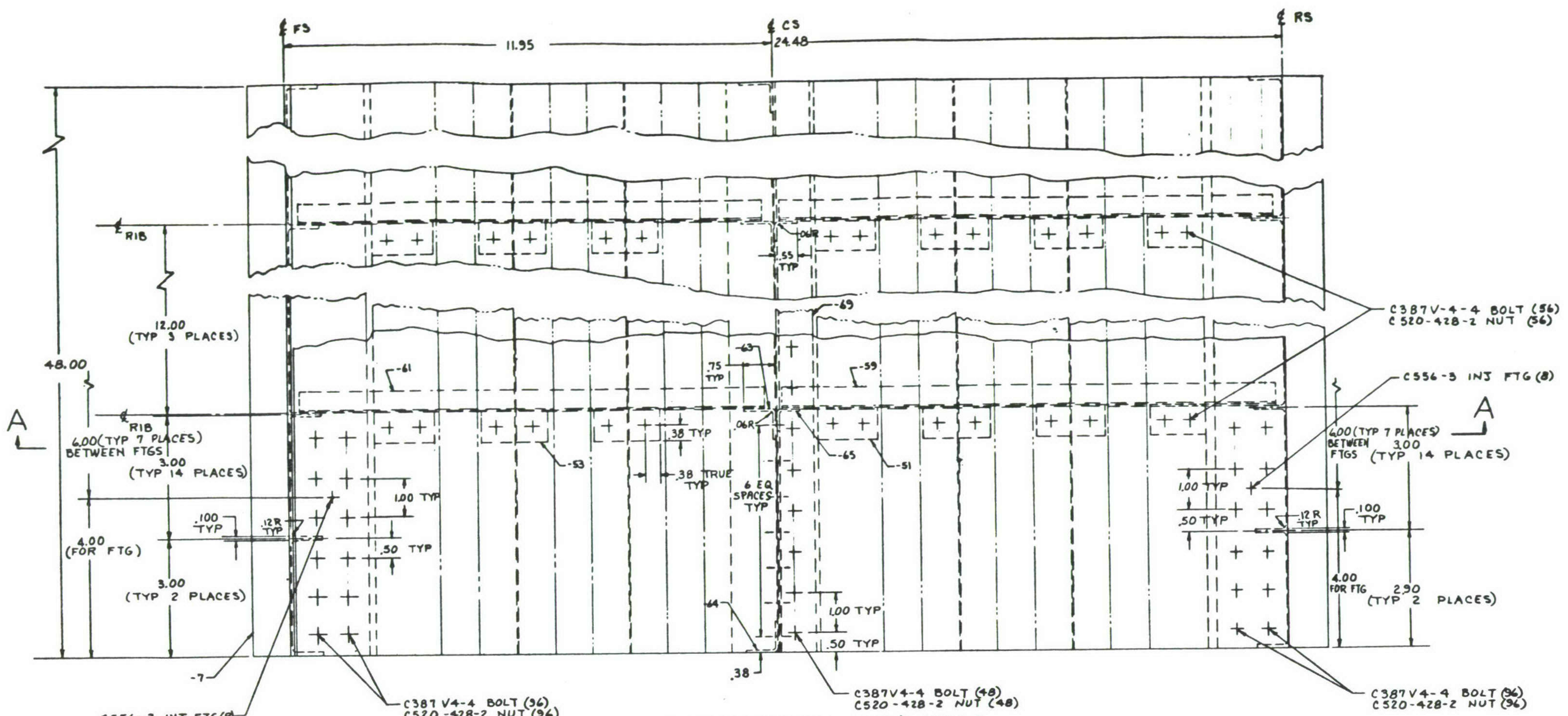
PRELIMINARY DESIGN DRAWING

ANALYTICAL ASSY~
BASELINE CONFIG. MACHINED
AL ~ (CSS 340.0)

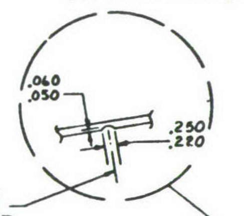
GENERAL DYNAMICS
Convair Aerospace Division

610RA100

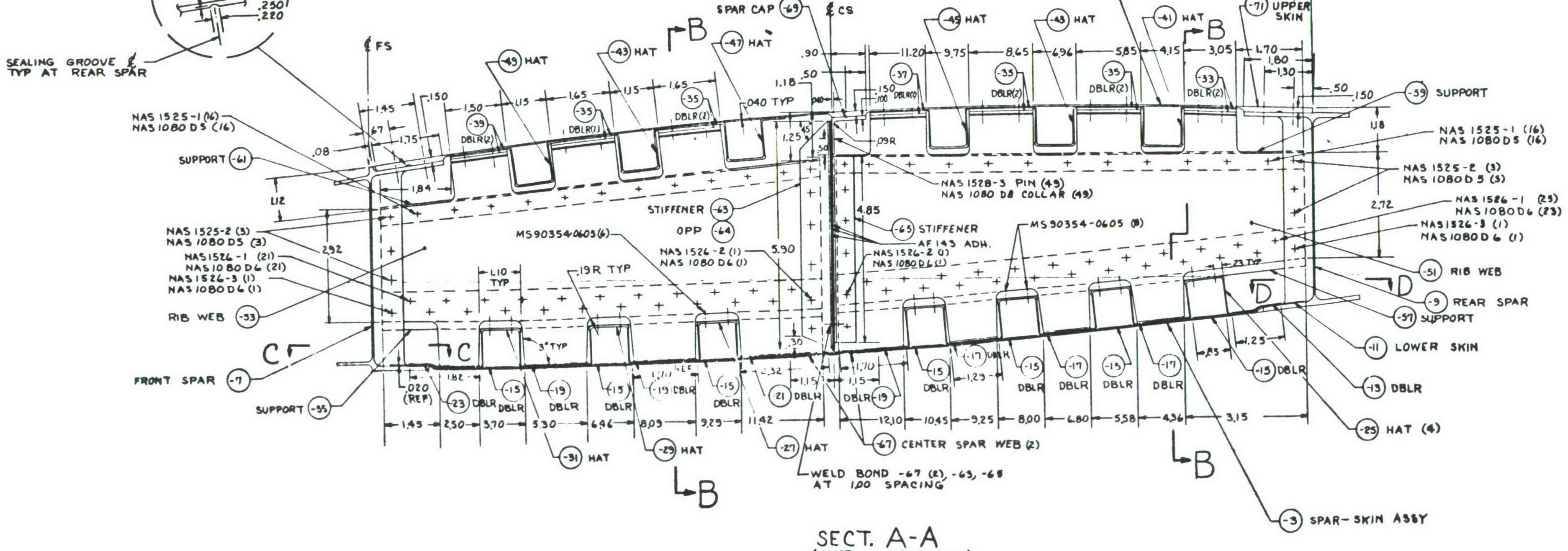
349/350



-1 ANALYTICAL ASSEMBLY
VIEW LOOKING DOWN AT
UPPER SURFACE
(CENTER SPAR STA 340.00)



SEALING GROOVE ℄ TYP AT REAR SPAR



SECT. A-A
(TYP 4 LOCATIONS)

-1 ANALYTICAL ASSY - CONCEPT DATA SUMMARY 610RA101

DASH NO.	PART NAME	NO. REQD	RAW STOCK SIZE	RAW STOCK WT.	MATL.	MATL PROPS APPLICABLE TO CRIT. STRESS	STATIC LIMIT DES STRESS (F_x 155/19.5)	MAX OPERATING STRESS	K_T	ALLOW FATIGUE STRESS	FRACT TOUGH	K_{ISCC}	DAM. TOL CLASS	INSPECT-ABILITY CLASS	CRIT. CRACK LENGTH TYPE	MIN. NDI DEFECT CRACK LENGTH	ALLOW. FRACT. STRESS	FIN. WEIGHT IN LBS.	COST IN DOLLARS
-3	SPAR-SKIN ASSY	1	—	—	—	12.4 KSI	F=71 KSI (66)	56 KSI								.15/UT		—	326.70
-7	FRONT SPAR	1	.31X6.0X54.	100.00	7050-T76 AL													4.27	259.46
-9	REAR SPAR	1	3.2X5.75X54	99.30														4.75	251.83
-11	LOWER SKIN	1	.020X24.9X48.5	2.41														2.04	6.75
-13	DOUBLER	1	.016X1.7X48.5	.13														.096	1.37
-15		7	.016X1.35X48.5	.10														.065	7.44
-17		3	.016X1.8X48.5	.14														.098	3.38
-19		3	.016X2.2X48.5	.17														.129	3.44
-21		1	.016X2.8X48.5	.21														.177	1.45
-23	DOUBLER	1	.016X2.3X48.5	.18														.133	1.47
-25	HAT	4	.080X5.8X60.0	2.40														.800	8.83
-27		1	.080X5.7X60.0	2.76														.888	4.58
-29		1	.080X5.3X60.0	2.56														.840	6.36
-31	HAT	1	.080X5.6X60.0	2.70														.874	4.62
-51	RIB WEB	4	.020X8.35X12.1	.21														.128	2.69
-53	RIB WEB	4	.020X8.3X12.0	.20														.121	2.67
-55	SUPPORT	4	.180X1.0X12.0	.84														.250	35.80
-57		4	.180X1.0X12.6	.88														.265	35.85
-59		4	.032X1.5X12.0	.06														.039	4.34
-61	SUPPORT	4	.032X1.5X12.0	.06														.037	4.34
-63	STIFF.	8	.040X2.0X6.4	.05														.035	8.62
-64		1	.040X2.0X6.4	.05														.035	1.13
-65	STIFF.	1	.032X1.6X5.3	.03														.017	1.11
-67	CENTER SPAR WEB	2	.020X7.7X60.0	.92														.631	3.51
-69	SPAR CAP	1	.90X1.0X60.0	5.40														.613	39.60
-33	DOUBLER	1	.080X1.8X48.5	.72														.520	2.57
-35		4	.080X2.2X48.5	.85														.650	9.91
-37		1	.080X1.9X48.5	.75														.550	2.61
-39	DOUBLER	1	.080X2.0X48.5	.77	7050-T76 AL													.590	2.43
—	ADHESIVE	AR	22.6 SQ.FT.															2.26	11.30
-5	SKIN PANEL ASSY SEE TABLE I	1				20.7 KSI	F=116 KSI (92)	92 KSI								.100 PEN		16.26	83.61
NAS1525-1	PIN	128			AL												HEAD ONLY	.030	10.24
NAS1525-2		24			AL													.017	1.92
NAS1526-1		176			AL													.176	44.00
NAS1526-2		8			AL													.008	2.00
NAS1526-3		8			AL													.008	2.00
NAS1528-3	PIN	49			AL													.098	9.26
NAS1080D5	COLLAR	152			AL													.106	3.04
NAS1080D6	COLLAR	192			AL													.192	3.84
NAS1080D8	COLLAR	49			AL													.098	.98
MS90354-0605	BLIND FASTENER	56			STL													.386	16.80
C556-3	INJ. FTG	16			TI													.059	15.08
C387V4-4	BOLT	296			TI													1.52	266.40
C520-428-2	NUT	296			STL													1.52	115.44
-1	ASSY																	—	850.91
																	GRAND TOTAL	51.12	2146.90

TABLE I

-5 SKIN PANEL ASSEMBLY

DASH NO.	PART NAME	RAW STOCK SIZE	RAW STOCK WT.	MATERIAL	FINISHED STOCK SIZE	FINISHED WT. IN LBS.	NO. REQD
-71	UPPER SKIN	.150X30.5X60.0	27.0	7050-T76 ALUMINUM ALLOY SHEET	—	7.00	1
-41	HAT	.040X6.0X60.0	1.44		—	.88	1
-43	HAT	.040X5.3X60.0	1.27		—	.77	2
-45	HAT	.040X6.0X60.0	1.44		—	.88	1
-47	HAT	.040X5.0X60.0	1.20		—	.73	1
-49	HAT	.040X6.1X60.0	1.46		—	.90	1
-33	DBLR	.080X1.85X48.5	.72		.080X1.35X48.0	.52	1
-35	DBLR	.080X2.20X48.5	.85		.080X1.70X48.0	.65	4
-37	DBLR	.080X1.95X48.5	.75		.080X1.45X48.0	.55	1
-39	DBLR	.080X2.00X48.5	.77		.080X1.50X48.0	.57	1
—	ADHESIVE	9 SQ.FT.	—	AF 143 (3M)	—	.90	—

TOTAL 16.26

NOTES:

3. INSTALL C556 INJECTION FITTINGS PER M076 EQUALLY SPACED BETWEEN FASTENERS AS SHOWN AND CENTERED ON THE SEALING GROOVE. PLUG WITH NAS1081-06A3 SCREWS.
2. THE FAYING SURFACES AT THE FRONT AND REAR SPARS AND ALL FASTENERS, SHALL BE SEALED PER FPS-1004.
1. USE AF 143 ADHESIVE (3M COMPANY) BETWEEN LOWER SURFACE SKIN AND ALL ADJACENT DOUBLERS, HATS, CENTER SPAR WEB FLANGE & SPARS; USE BETWEEN UPPER SURFACE SKIN AND ALL ADJACENT DOUBLERS & HATS; USE BETWEEN CENTER SPAR WEB AND STIFFENERS.

PRELIMINARY DESIGN DRAWING

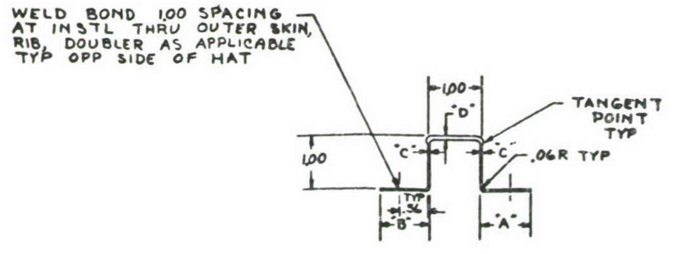
ANALYTICAL ASSY - ADHESIVE BONDED HAT STIFFENERS, ALUMINUM; CSS340

SCALE 1/1 DATE 1/4/73

GENERAL DYNAMICS
Convair Aerospace Division
Fort Worth Operation

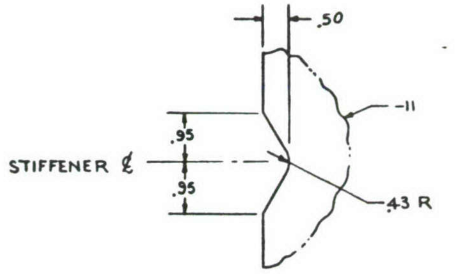
610RA101

Sheet 1 351/352

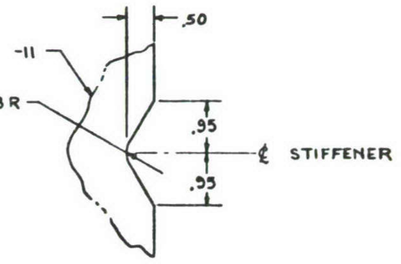


DETAIL OF -25, -27, -29, -31, -41, -43, -45, -47 & -49

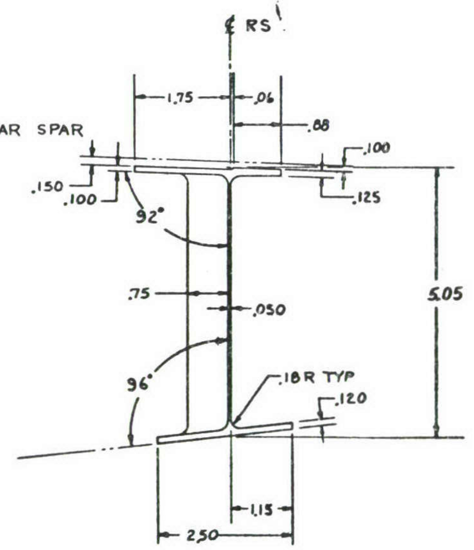
DASH NO.	"A" DIM.	"B" DIM.	"C" DIM.	"D" DIM.
-25	.75	.75	.025	.080
-27	1.35	.90	.025	.080
-29	.95	.90	.025	.080
-31	.95	1.20	.025	.080
-41	.95	1.45	.032	.040
-43	.90	.95	.032	.040
-45	1.55	.95	.032	.040
-47	.90	.65	.032	.040
-49	1.60	.95	.032	.040



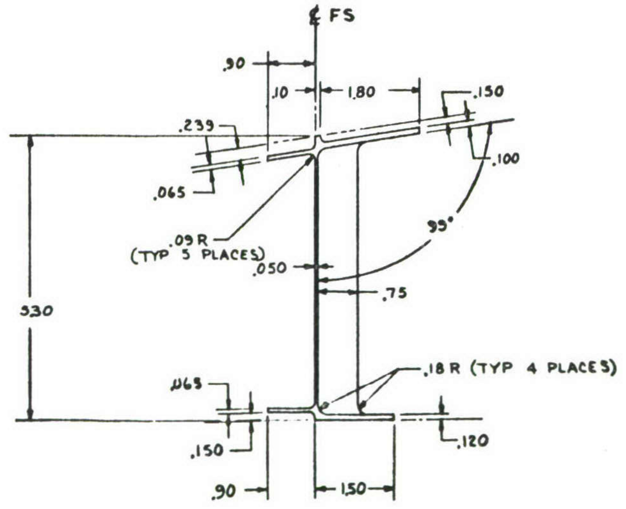
SECT. C-C
TYP CUTOUT AT ALL FRONT SPAR STIFFENERS



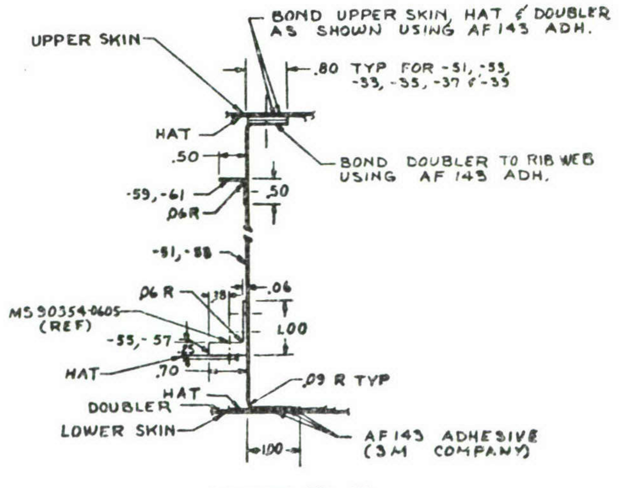
SECT. D-D
TYP CUTOUT AT ALL REAR SPAR STIFFENERS



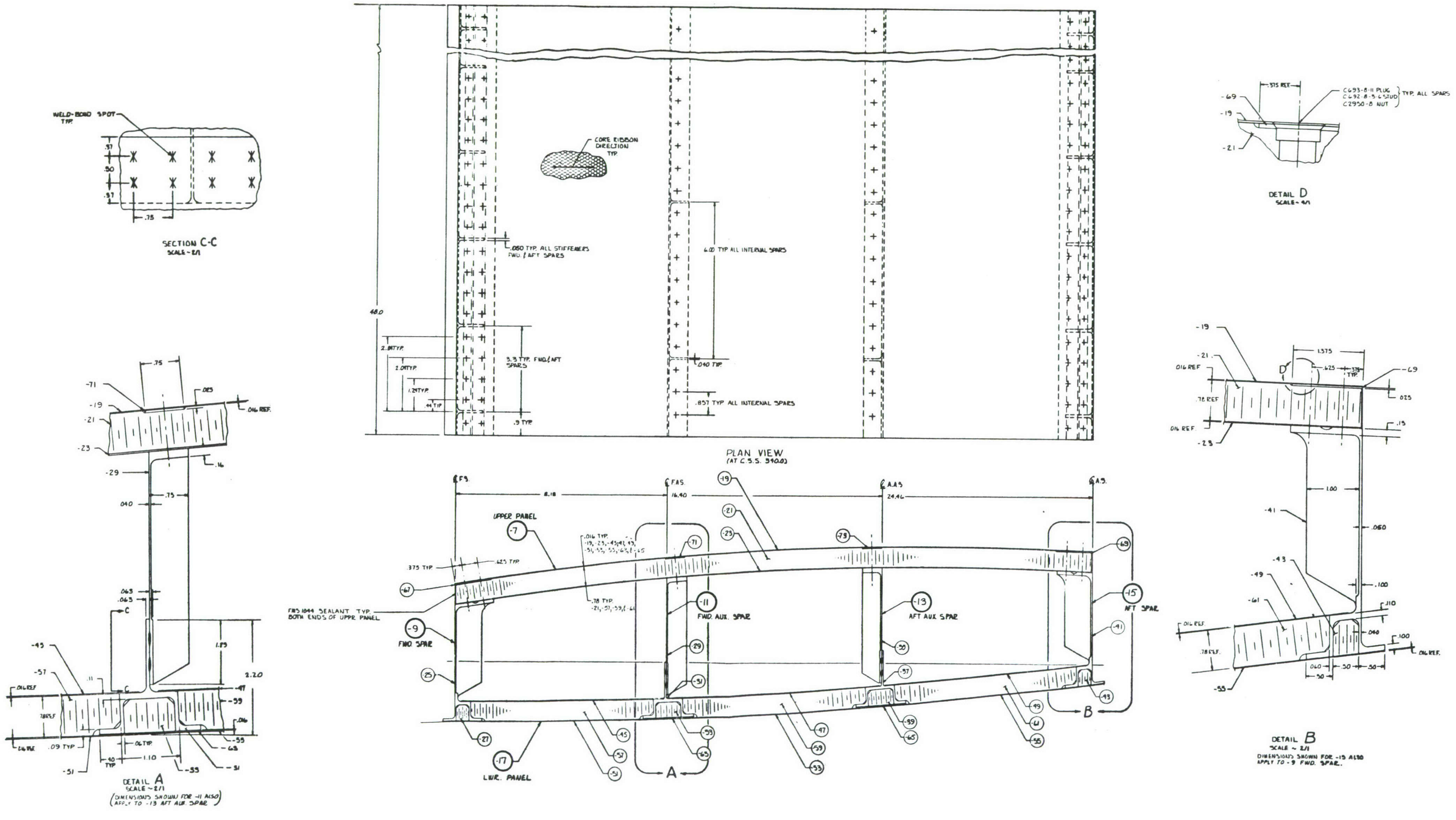
DETAIL OF -9



DETAIL OF -7



SECT. B-B



DASH NO.	PART NAME	NO. REQ'D	RAW STOCK SIZE	RAW STOCK WEIGHT	MAT'L.
-7	UPPER PANEL	–	–	(9.868)	–
-19	OUTER SKIN	1	.016 x 25 x 54	2.21	AL 7050-T76
-21	CORE	1	[illegible] x 25 x 54	4.76	P006-IC
-23	INNER SKIN	1	.016 x 25 x 54	2.21	AL 7050-T76
-67	FWD. SHIM	1	[illegible]	.206	
-69	AFT SHIM	1	[illegible]	.206	
-71	FWD. AUX. SHIM	1	[illegible]	.172	
-75	AFT AUX. SHIM	1	[illegible]	.172	AL 7050-T76
-9	FWD. SPAR	–	–	(55.19)	–
-25	SPAR	1	2.0 x 5.0 x 54	55.00	AL 7050-T73651
-27	CORE	1	1.0 x 1.0 x 54	.19	P006-IC
-11	FWD. AUX. SPAR	–	–	(50.786)	–
-29	SPAR WEB	1	.075 x 4.75 x 54	22.95	AL 7050-T7651
-31	LWR. CAP	1	2.0 x 2.5 x 54 EXTR.	27.55	AL 7050-T73651
-33	CORE	1	1.0 x 1.5 x 54	.286	P006-IC
-13	AFT AUX. SPAR	–	–	(50.786)	–
-35	SPAR WEB	1	.075 x 4.75 x 54	22.95	AL 7050-T7651
-37	LWR. CAP	1	2.0 x 2.5 x 54 EXTR.	27.55	AL 7050-T73651
-39	CORE	1	1.0 x 1.5 x 54	.286	P006-IC
-15	AFT SPAR	–	–	(55.19)	–
-41	SPAR	1	2.0 x 4.75 x 54	55.00	AL 7050-T73651
-43	CORE	1	1.0 x 1.0 x 54	.19	P006-IC
-17	LOWER PANEL	–	–	9.58	–
-45	INNER SKIN, 1	1	.016 x 8.25 x 54	.728	AL 7050-T76
-47	INNER SKIN, 2	1	.016 x 8.5 x 54	.750	
-49	INNER SKIN, 3	1	.016 x 8.25 x 54	.728	
-51	OUTER SKIN, 1	1	.016 x 9.25 x 54	.815	
-53	OUTER SKIN, 2	1	.016 x 8.5 x 54	.750	
-55	OUTER SKIN, 3	1	.016 x 9.0 x 54	.794	AL 7050-T76
-57	CORE, 1	1	1.0 x 8.0 x 54	1.525	P006-IC
-59	CORE, 2	1	1.0 x 8.0 x 54	1.525	P006-IC
-61	CORE, 3	1	1.0 x 8.0 x 54	1.525	P006-IC
-63	SPLICE PLATE, F.A.S.	1	.016 x 2.5 x 54	.22	AL 7050-T76
-65	SPLICE PLATE, A.A.S.	1	.016 x 2.5 x 54	.22	AL 7050-T76
-	ADHESIVE	AR	–	5.00	AF-143
-	SEALANT	AR	–	.126	FMS 1044 TY II CL B.
-	PLUG	342	–	2.052	C693-8-11
-	STUD	342	–	4.56	C692-8-5-6
-	NUT	342	–	.889	C2950-8

ANALYTICAL ASSY ~ CONCEPT DATA SUMMARY — 610RA-102

DASH NO.	PART NAME	NO. REQ'D	RAW STOCK SIZE	RAW STOCK WEIGHT	MAT'L	MAT'L PROPS APPLICABLE TO CRIT. STRESS	STATIC LIMIT DES STRESS (F = 1.5)	MAX. OPERATING STRESS	K_T	ALLOW FATIGUE STRESS	FRACT. TOUGH	K_{ISC}	DAM TOL CLASS	INSPECT-ABILITY CLASS	CRIT. CRACK LENGTH/TYPE	MIN NDI DETECT CRACK LEN./METH	ALLOW FRACT STRESS	FIN. WT. IN LBS.	COST IN DOLLARS
-7	UPPER PANEL	1	SEE TABLE		SEE TABLE	39 KSI		22.9 KSI								.180 UT PEN		9.371	33.29
-9	FWD. SPAR	1														.100/UT, PEN, X-RAY		5.914	111.[illegible]
-11	FWD. AUX. SPAR	1																4.938	124.[illegible]
-13	AFT AUX. SPAR	1																4.916	124.[illegible]
-15	AFT SPAR	1														.100/UT, PEN, X-RAY		5.906	111.[illegible]
-17	LWR. PANEL	1	SEE TABLE		SEE TABLE	39 KSI	F = 22.5 KSI (17.8)	17.8 KSI	2.0	27 KSI						.150 UT PEN	37 KSI	8.794	48.98
-1	ASS'Y																		2152.[illegible]
																		39.94	2,713.00

NOTES ~ 1. INTERNAL SPARS ARE PARALLEL TO FRONT SPAR.
2. LWR SPAR CAP STIFFENING CORE (-27, -33, -39, (-43) CAN BE BONDED IN PLACE FIRST AND THEN BOND SPAR INTO LWR PANEL.

PRELIMINARY DESIGN DRAWING

ANALYTICAL ASSY ~ SANDWICH SKIN PANELS, INTEGRAL LOWER SPAR CAPS

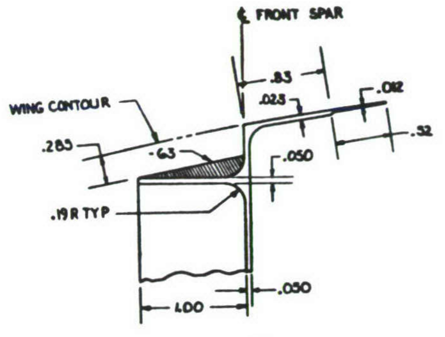
(REF 610R-117)

BY | APPROVED | SCALE | DATE 1/3/73

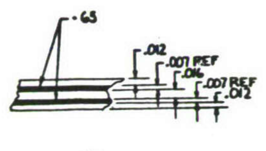
GENERAL DYNAMICS
Convair Aerospace Division
Fort Worth Operation

610RA-102

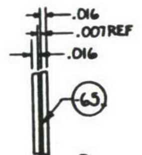
SHEET



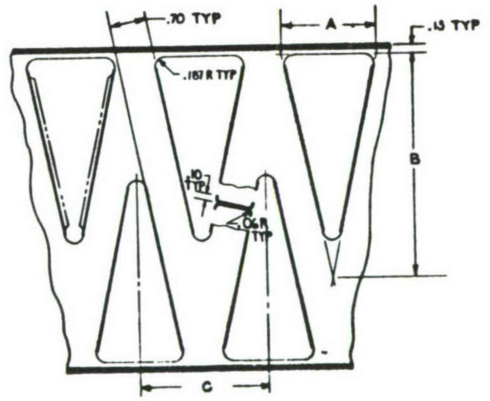
DETAIL -51
CONSTRUCTION SIMILAR FOR REAR SPAR (-53)
SCALE~ TWICE SIZE



VIEW C
NO SCALE



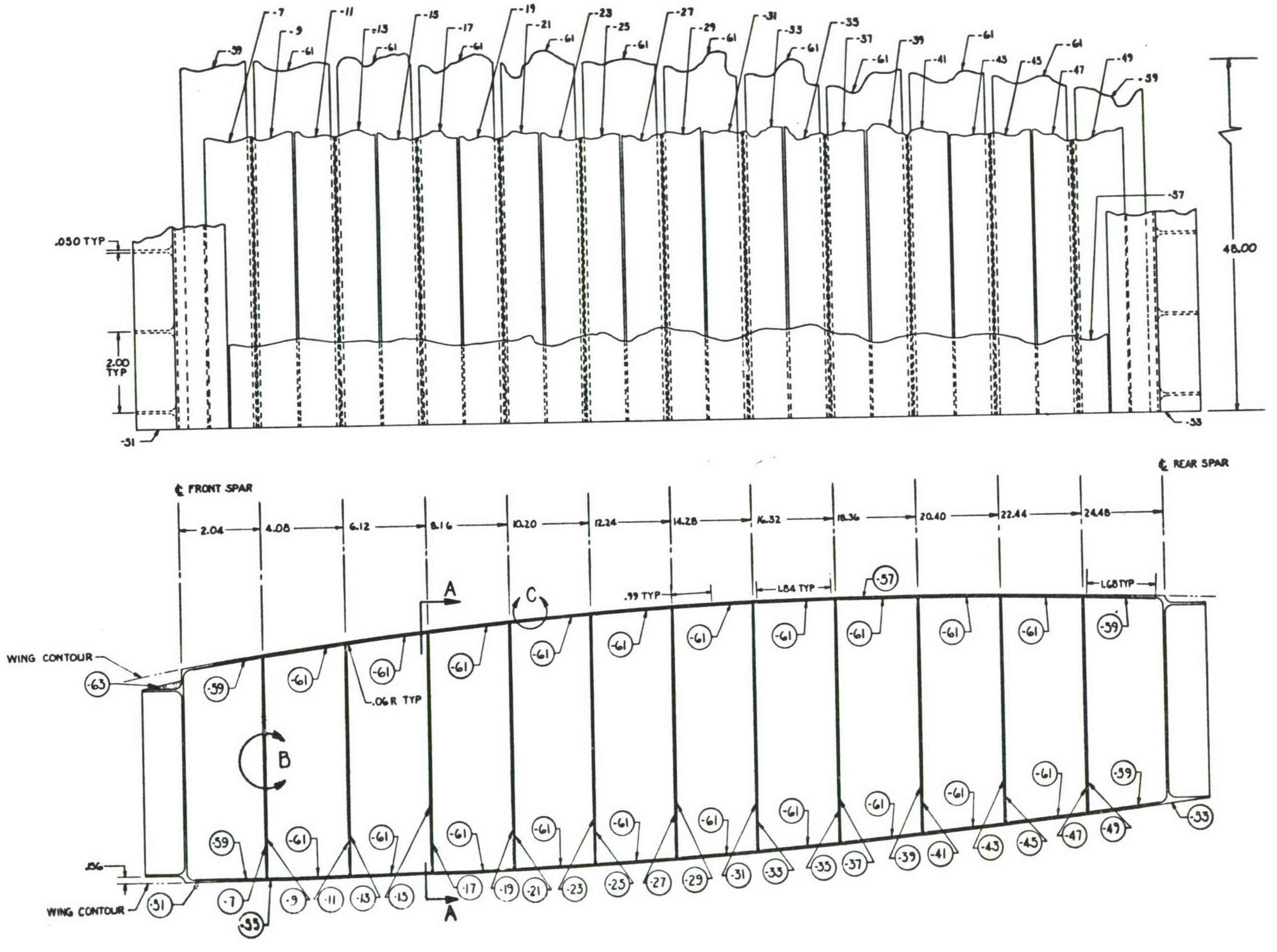
VIEW B
NO SCALE



SECTION A-A
SEE TABLE I

DASH NUMBER	A	B	C
-7/-9	1.67	3.86	2.44
-11/-13	1.78	4.09	2.54
-15/-17	1.84	4.28	2.60
-19/-21	1.90	4.42	2.66
-23/-25	1.92	4.55	2.68
-27/-29	1.93	4.58	2.70
-31/-33	1.91	4.53	2.66
-35/-37	1.89	4.39	2.62
-39/-41	1.80	4.19	2.54
-43/-45	1.69	3.95	2.46
-47/-49	1.58	3.68	2.32

TABLE I



-1 WING BOX ASSY

-1 ANALYTICAL ASSY ~ CONCEPT DATA SUMMARY G1ORA103

DASH NO.	PART NAME	NO. REQD	RAW STOCK SIZE	RAW STOCK WEIGHT	MAT'L	MAT'L PROPS APPLICABLE TO CRIT. STRESS	STATIC LIMIT DES STRESS (F)	MAX. OPERATING STRESS	K_T	ALLOW FATIGUE STRESS	FRACT. TOUGH. K_{IC}	DAM. TOL. CLASS.	INSPECT-ABILITY CLASS.	CRIT. CRACK LENGTH/TYPE	MIN. NDI DETECT. CRACK LEN/WIDTH	ALLOW FRACT. STRESS	FIN. WT. IN LBS.	COST IN DOLLARS
-7	INTERIOR SPAR HALF	1	.016x8x49	.63	7050-T76 AL	F_{TU} = 70 KSI	F = 4.68 KSI (3.72) (TYP)	3.72 KSI	8.0	27.6 KSI			NOT INSPECTED			40.0 KSI	.362	2.37
-9			.016x8x49	.63													.362	2.37
-11			.016x8x49	.63													.342	2.37
-13			.016x8x49	.63													.342	2.37
-15			.016x9x49	.71													.360	2.53
-17			.016x9x49	.71													.360	2.53
-19			.016x9x49	.71													.356	2.53
-21			.016x9x49	.71													.356	2.53
-23			.016x9x49	.71													.351	2.53
-25			.016x9x49	.71													.351	2.53
-27			.016x9x49	.71													.349	2.53
-29			.016x9x49	.71													.349	2.53
-31			.016x9x49	.71													.352	2.53
-33			.016x9x49	.71													.351	2.53
-35			.016x9x49	.71													.354	2.53
-37			.016x9x49	.71													.354	2.53
-39			.016x8x49	.63													.351	2.37
-41			.016x8x49	.63													.351	2.37
-43			.016x8x49	.63													.350	2.37
-45			.016x8x49	.63													.350	2.37
-47			.016x8x49	.63													.365	2.37
-49	INTERIOR SPAR HALF	1	.016x8x49	.63		F_{TU} = 70 KSI											.365	2.37
-51	FRONT SPAR	1	6.0x2.6x54	84.24		F_S = 41.5 KSI	F = 13.09 KSI (10.40)	10.40 KSI	—	—						—	2.716	222.63
-53	REAR SPAR	1	5.8x2.6x54	81.43		F_S = 41.5 KSI	F = 9.33 (7.42)	7.42 KSI	—	—						—	2.776	216.07
-55	LOWER SKIN	1	.012x29x54	1.88		F_{TU} = 70 KSI	F = 12.67 (10.14)	10.14 KSI	1.0	37.3 KSI					.15/UT	40.0 KSI	1.259	4.79
-57	UPPER SKIN	1	.012x29x54	1.88		F_C = 23.25 (K_T = 62.5)	F = 15.50 (12.32)	12.32 KSI	—	—					.15/UT	—	1.261	4.79
-59	SKIN	4	.012x22x49	.52													.387	5.11
-61	SKIN	20	.012x2.3x49	2.80	7050-T76 ALUM												2.120	25.91
-63	SHIM	1			GRP												1.104	.10
-65	ADHESIVE	AR			AF143												5.400	27.00
-1	ASSY																—	1491.75
																TOTAL	24.807	2052.01

PRELIMINARY DESIGN DRAWING

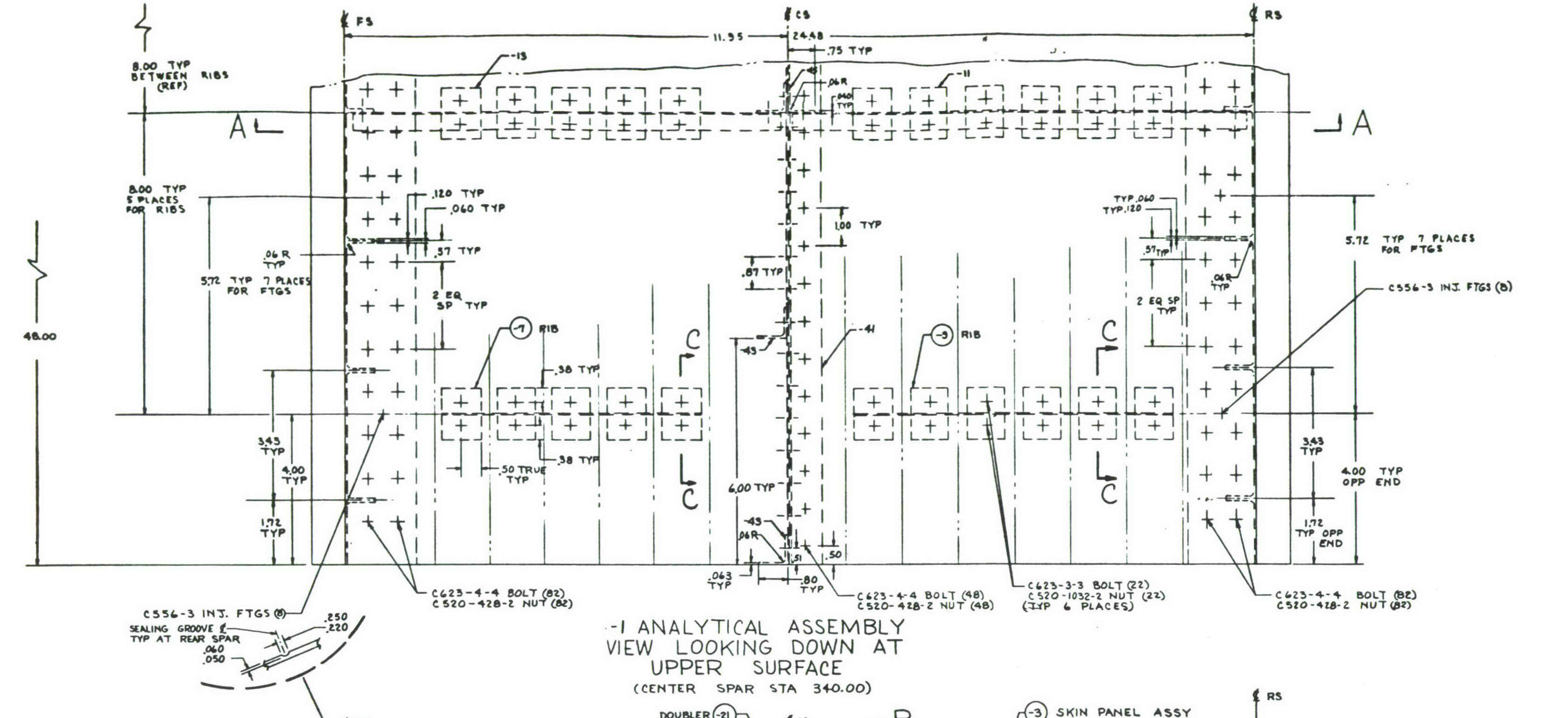
WING SECTION ~ ADHESIVE BONDED CLOSE SPAR SPACING (CS5340)

SCALE FULL DATE 1/9/73

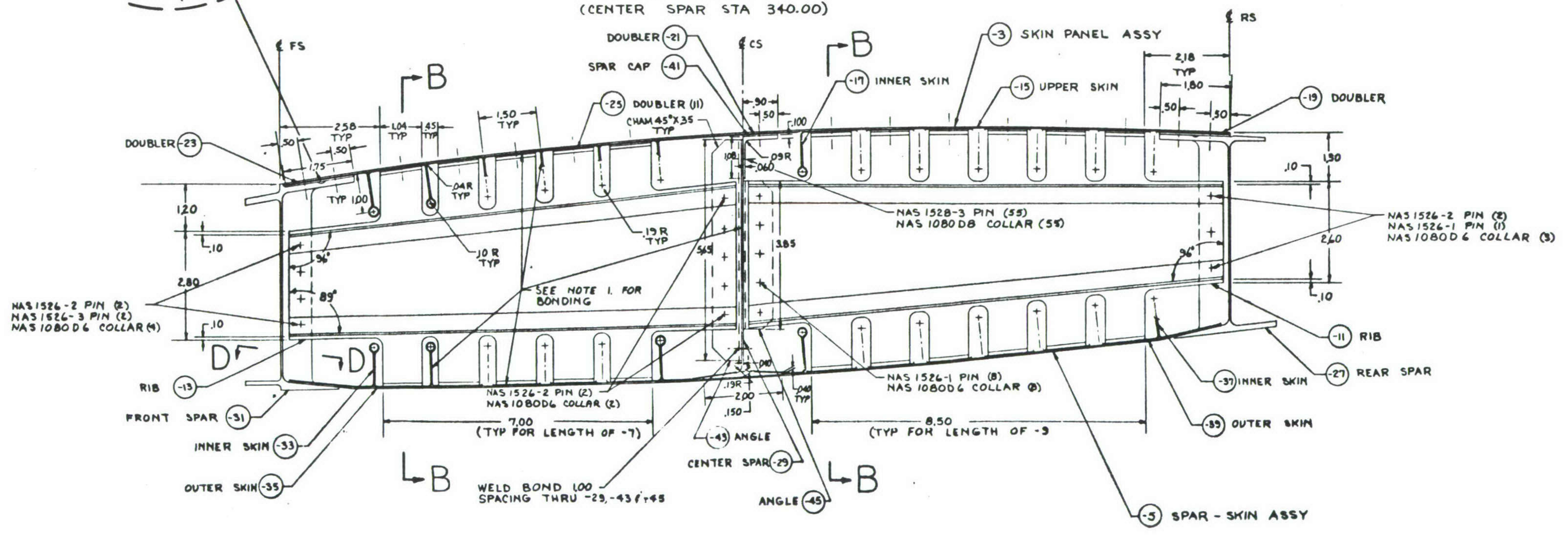
GENERAL DYNAMICS
Convair Aerospace Division
Fort Worth Operation

G1ORA103

357/358



-1 ANALYTICAL ASSEMBLY
VIEW LOOKING DOWN AT
UPPER SURFACE
(CENTER SPAR STA 340.00)



SECT. A-A

TABLE I

-3 SKIN PANEL ASSEMBLY

DASH NO.	PART NAME	RAW STOCK SIZE	RAW STOCK WT.	MATERIAL	FINISHED STOCK SIZE	FINISHED WT. IN LBS.	NO. REQD
-15	UPPER SKIN	.032 X 30.5 X 54.0	5.27	7050-T76 AL	.032 X 24.5 X 48.0	3.76	1
-17	INNER SKIN	.020 X 61.7 X 54.0	6.66		.020 X 55.7 X 48.0	5.35	1
-19	DOUBLER	.063 X 2.3 X 54.0	.78		.063 X 1.8 X 48.0	.54	1
-21	DOUBLER	.063 X 1.4 X 54.0	.47		.063 X .9 X 48.0	.27	1
-23	DOUBLER	.063 X 2.2 X 54.0	.76		.063 X 1.7 X 48.0	.53	1
-25	DOUBLER	.040 X 1.5 X 1.9	.01	7050-T76 AL	.040 X 1.0 X 1.4	.006	66
–	ADHESIVE	14.9 SQ FT	–	AF 143 (3M)	–	1.49	AR

TOTAL 12.30

TABLE II

-5 SPAR- SKIN ASSEMBLY

DASH NO.	PART NAME	RAW STOCK SIZE	RAW STOCK WT.	MATERIAL	FINISHED STOCK SIZE	FINISHED WT. IN LBS.	NO. REQD
-7	RIB	–	–	PREMIUM	–	.187	4
-9	RIB	–	–	AL CASTING	–	.223	4
-11	RIB	–	–	FMS-XXX	–	.48	2
-13	RIB	–	–		–	.44	2
-27	REAR SPAR	3.2 X 5.7 X 54.0	99.30	7050-T76 AL	–	5.24	1
-29	CENTER SPAR	2.2 X 6.6 X 54.0	80.19		–	2.11	1
-31	FRONT SPAR	3.1 X 6.0 X 54.0	100.00		–	5.41	1
-33	INNER SKIN	.016 X 33.0 X 54.0	2.85		.016 X 27.0 X 48.0	2.07	1
-35	OUTER SKIN	.016 X 17.8 X 54.0	1.53		.016 X 11.8 X 48.0	.91	1
-37	INNER SKIN	.016 X 35.8 X 54.0	3.09		.016 X 29.9 X 48.0	2.29	1
-39	OUTER SKIN	.016 X 18.0 X 54.0	1.55		.016 X 12.0 X 48.0	.92	1
-41	SPAR CAP	1.4 X 1.5 X 54.0	9.83		–	.46	1
-43	ANGLE	1.0 X 1.0 X 9.0	.90		–	.055	9
-45	ANGLE	1.0 X 1.0 X 7.0	.70	7050-T76 AL	–	.022	2
–	ADHESIVE	15 SQ FT	–	AF 143 (3M)	–	1.50	AR
NAS 1526-1	PIN	–	–	AL	HEAD ONLY	.002	18
NAS 1526-2	PIN	–	–	AL	HEAD ONLY	.002	12
NAS 1526-3	PIN	–	–	AL	HEAD ONLY	.002	4
NAS 1528-3	PIN	–	–	AL	HEAD ONLY	.002	55
NAS 1080D6	COLLAR	–	–	AL		.002	34
NAS 1080D8	COLLAR	–	–	AL		.002	55

TOTAL 25.28

-1 ANALYTICAL ASSY- CONCEPT DATA SUMMARY 610RA104

DASH NO.	PART NAME	NO. REQD	RAW STOCK SIZE	RAW STOCK WT.	MATL.	MATL PROPS APPLICABLE TO CRIT. STRESS	STATIC LIMIT DES STRESS (F_s 15.9/12.5)	MAX OPERATING STRESS	K_T	ALLOW FATIGUE STRESS	FRACT TOUGH	K_{ISCC}	DAM TOL. CLASS	INSPECTABILITY CLASS	CRIT. CRACK LENGTH / TYPE	MIN. NDI DEFECT CRACK LENGTH / METH	ALLOW FRACT STRESS	FIN WEIGHT IN LBS.	COST IN DOLLARS
-3	SKIN PANEL ASSY	1	SEE	TABLE I		23.8KSI	F=16KSI (12.7)	12.7KSI								.15/UT X-RAY		12.30	38.73
-5	SPAR-SKIN ASSY	1	SEE	TABLE II		–		13.8KSI	1.25	36KSI						.15/UT X-RAY	33.3KSI	25.28	850.54
C556-3	INJ FTG	16			TI													.059	15.84
C623-4-4	BOLT	212			TI													1.39	642.36
C623-3-3	BOLT	132			TI													1.10	180.81
C520-428-2	NUT	212			STL													.33	83.04
C520-1032-2	NUT	132			STL													.30	62.04
-1 ASSY																			743.95
														GRAND TOTAL				40.75	2622.87

NOTES:-

1. USE AF 143 ADHESIVE (3M COMPANY) BETWEEN LOWER SURFACE SKIN, RIB FLANGES, CENTER SPAR AND FRONT SPAR AND REAR SPAR FLANGES; USE BETWEEN UPPER SURFACE SKIN AND ALL ADJACENT DOUBLERS; USE BETWEEN CENTER SPAR WEB AND STIFFENERS.
2. THE FAYING SURFACES AT THE FRONT AND REAR SPAR AND ALL FASTENERS SHALL BE SEALED PER FPS-1004.
3. INSTALL C556 INJECTION FITTINGS PER M076 EQUALLY SPACED BETWEEN FASTENERS AS SHOWN AND CENTERED ON THE SEALING GROOVE. PLUG WITH NAS1081-06A3 SCREWS.

PRELIMINARY DESIGN DRAWING

ANALYTICAL ASSY- INTEGRAL FORMED BULBED TEE, ALUMINUM; CSS 340

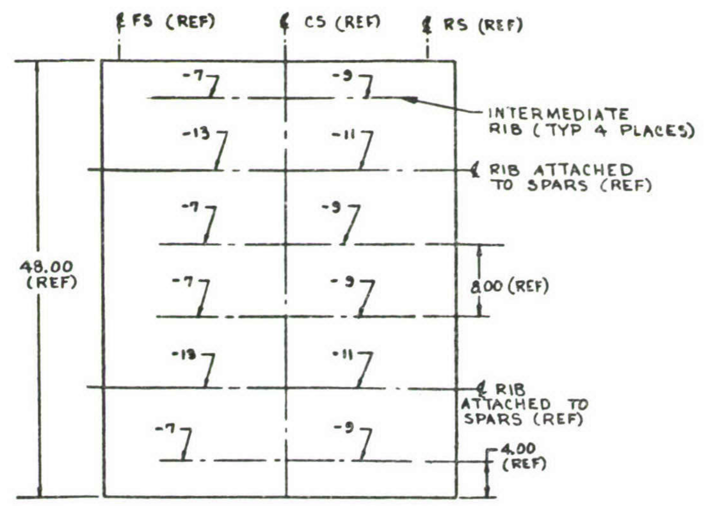
GENERAL DYNAMICS
Convair Aerospace Division

SCALE 1/1 DATE 2/5/73

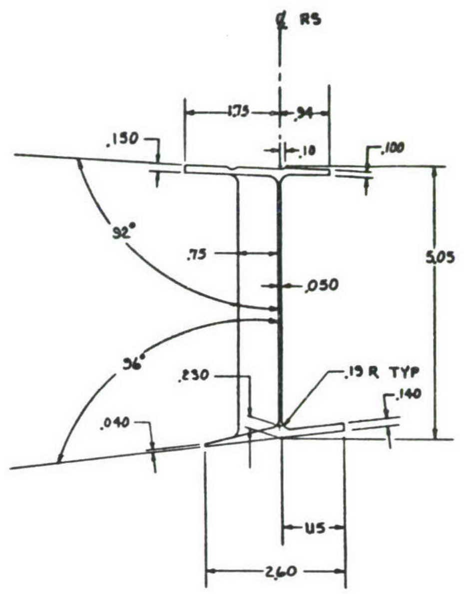
610RA104

SHEET 1

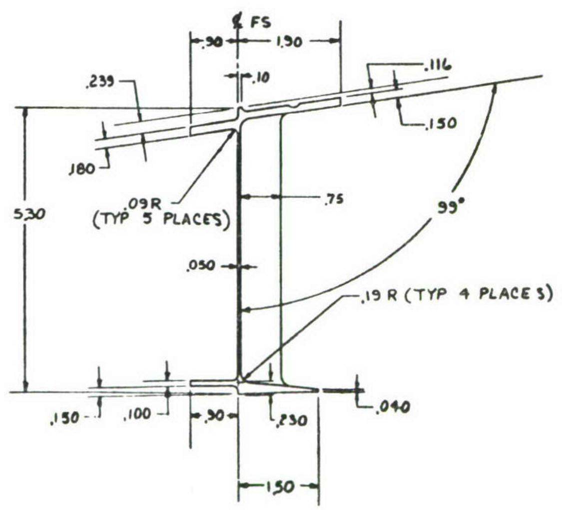
Sheet 1 359/360



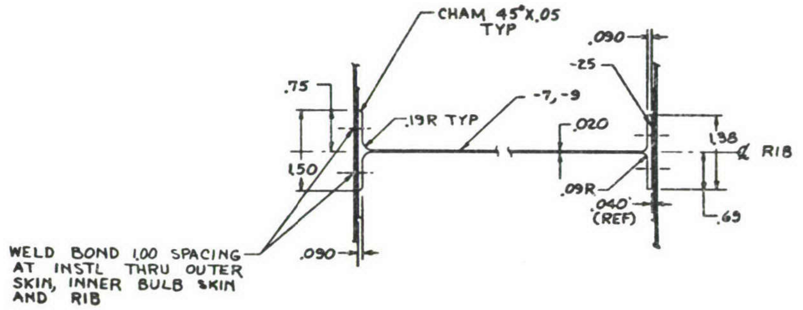
SCHEMATIC OF PLAN VIEW FOR LOCATION OF RIBS (NO SCALE)



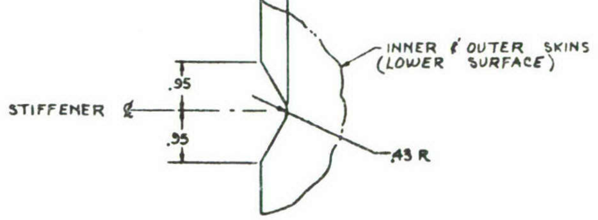
DETAIL OF -27



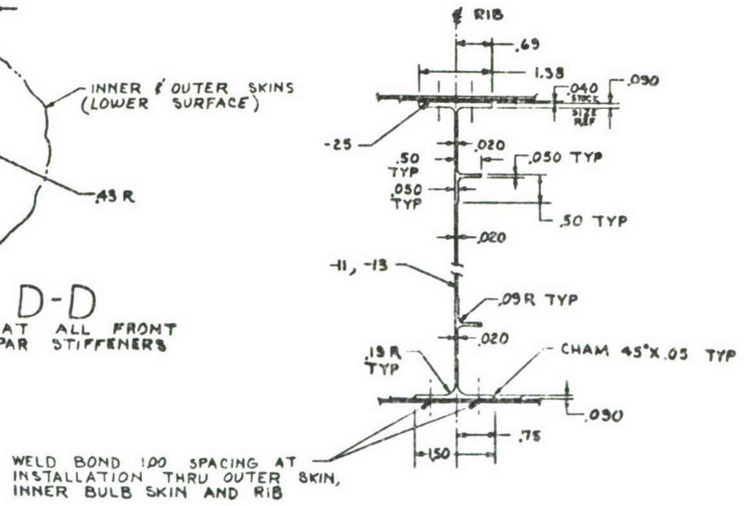
DETAIL OF -31



SECT. C-C

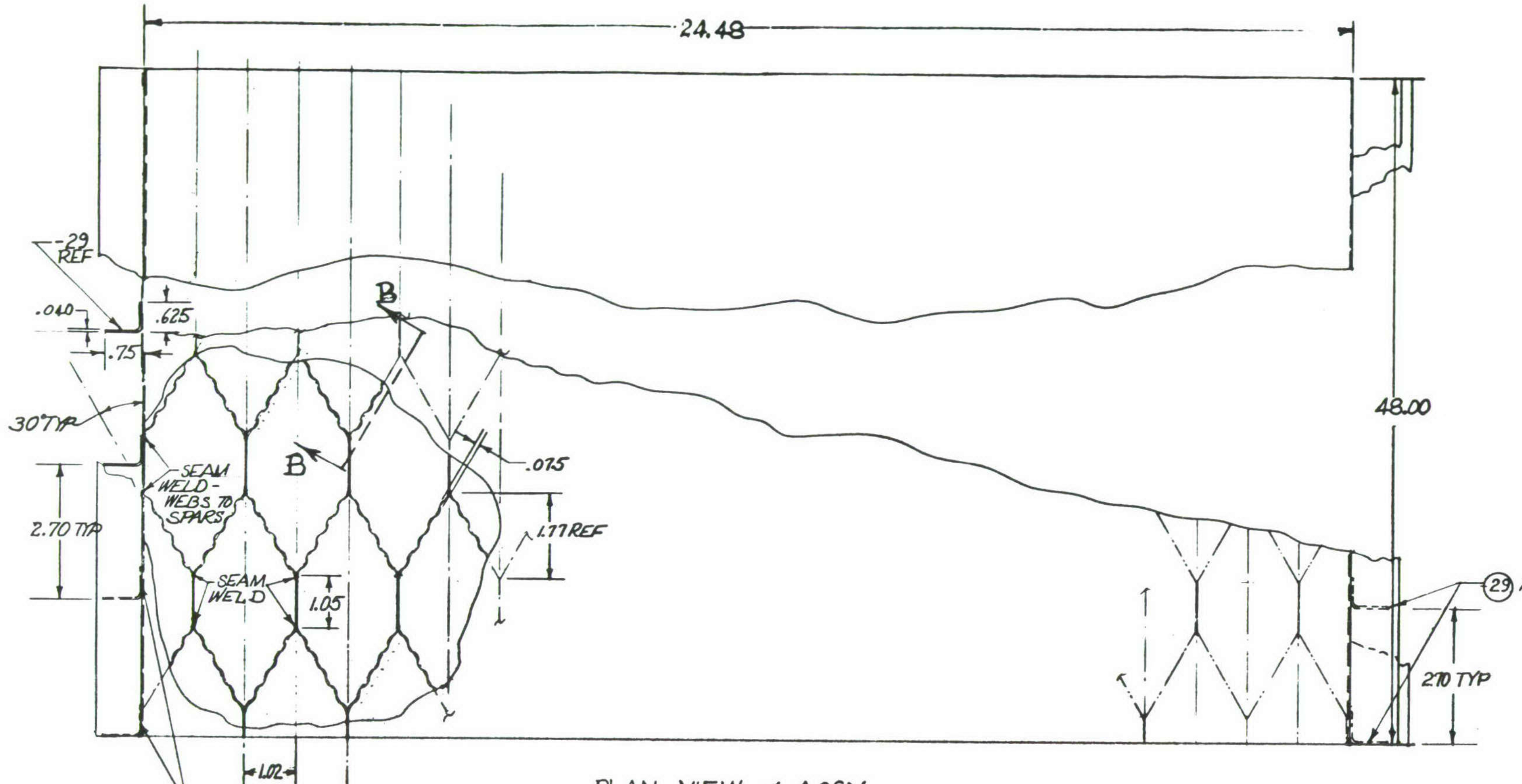


SECT. D-D
TYP CUTOUT AT ALL FRONT AND REAR SPAR STIFFENERS

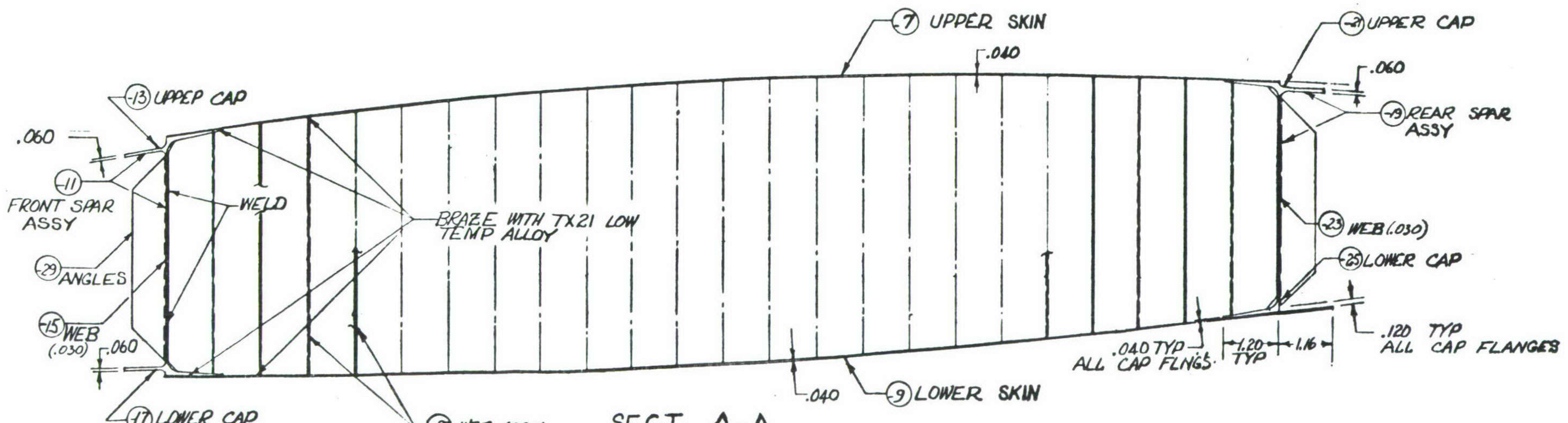


SECT. B-B

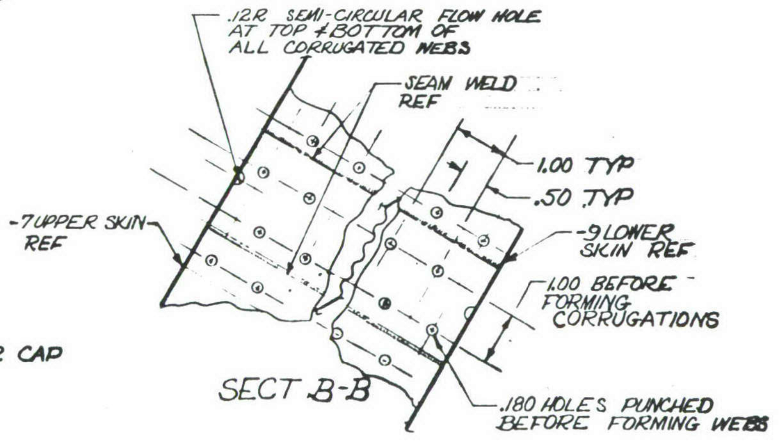
ANALYTICAL ASSY~ CONCEPT DATA SUMMARY																			610RA105
DASH NO.	PART NAME	NO REQD	RAW STOCK SIZE	RAW STOCK WEIGHT	MATL	MATL PROP'S APPLICABLE TO CRIT. STRESS	STATIC LIMIT DES STRESS (F× 2/3)	MAX. OPERAT'G STRESS	K_T	ALLOW FATIGUE STRESS	FRACT. TOUGH.	K_{IC}	DAM. TOL. CLASS.	INSPECT-ABILITY CLASS.	CRIT. CRACK LENGTH / TYPE	MIN. ND DETECT. CRACK LEN / METH	ALLOW. FRACT STRESS	FIN. WT. IN LBS	COST IN DOLLARS
-7	UPPER SKIN	1	.010 × 30 × 54	10.3	6AL4VTi (STA)		F_t = 18.60 ksi (14.78)	14.78 ksi	—	—						.09 PEN.	—	7.53	130.34
-9	LOWER SKIN	1	.040 × 30 × 54	10.3	6AL4VTi STA		F_t = 15.20 ksi (12.08)	12.08 ksi	—	—						.09 PEN	—	7.93	130.34
-11 FRONT SPAR ASSY																.100 UT PEN			21.45
-13	UPPER CAP	1	EXTR × 1.3 in² × 50	10.4	6AL-4V Ti STA													1.36	111.72
-15	WEB	1	.030 × 3.0 × 50	.72	↕													.68	13.02
-17	LOWER CAP	1	EXTR × 1.3 in² × 50	10.4	6AL-4V Ti (STA)		F_t = 12.93 ksi (10.28)	10.28 ksi	—	—							—	1.38	111.72
-19 REAR SPAR ASSY																.100/UT PEN			21.45
-21	UPPER CAP	1	EXTR × 1.3 in² × 50	10.4	6AL-4V Ti (STA)													1.36	111.72
-23	WEB	1	.030 × 30 × 50	.72	↕													.66	13.02
-25	LOWER CAP	1	EXTR × 1.0 × 50	8.00	6AL-4V Ti (STA)		F_t = 8.40 ksi (6.68)	6.68 ksi	—	—							—	.91	97.01
-27	WEB ASSY	1	24 pcs .005 × 6.5 × 60.0	12.55	COM PURE TI											.100/UT PEN		10.35	230.41
-29	ANGLE	36	.04 × .62 × .75 × 50	1.50	6AL4VTi STA													1.15	23.48
LOW TEMP BRAZE ALLOY				.75	TX-21													.68	35.85
-1 ASSY (FAB. COSTS)																		—	2754.71
																TOTALS		53.97	3805.64



PLAN VIEW -1 ASSY
FULL SIZE



SECT A-A
FULL SIZE



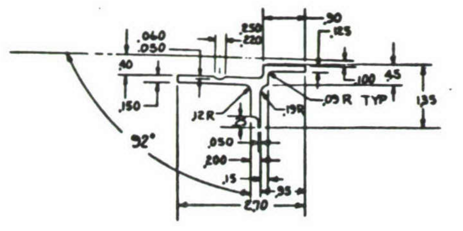
SECT B-B

PRELIMINARY DESIGN DRAWING

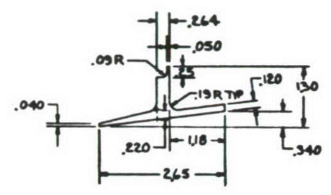
ANALYTICAL ASSY~ WING
MULTI-WET CELL CONSTRUCTION
(CS3 340.0)

GENERAL DYNAMICS
Convair Aerospace Division
Fort Worth Operation

610RA105



DETAIL OF -27



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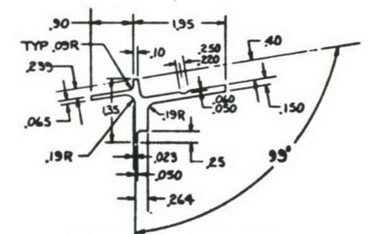
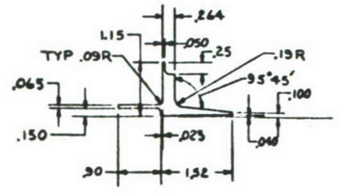
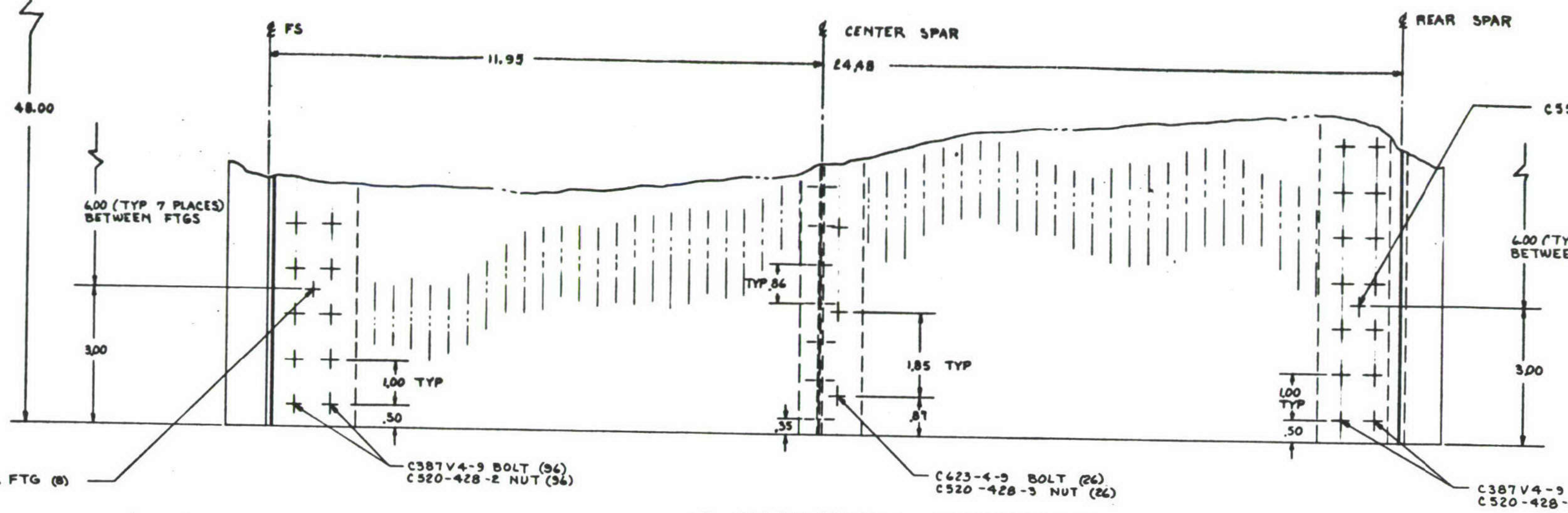


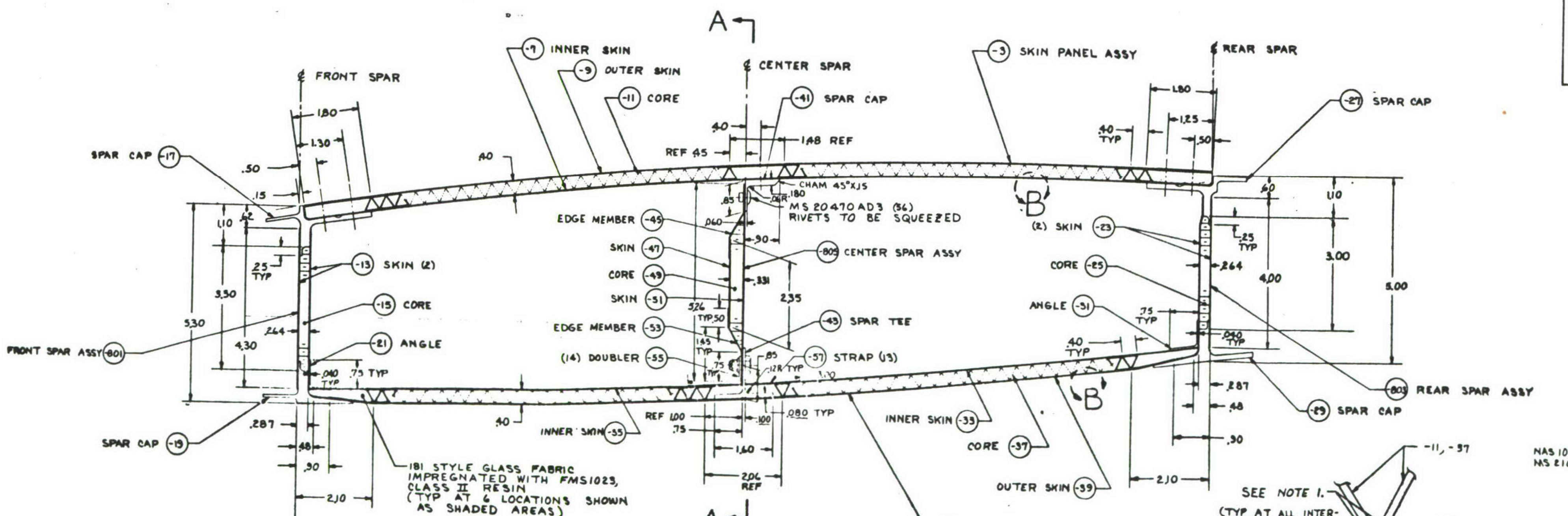
DETAIL OF -17

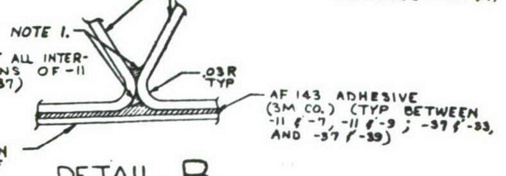


DETAIL OF -19

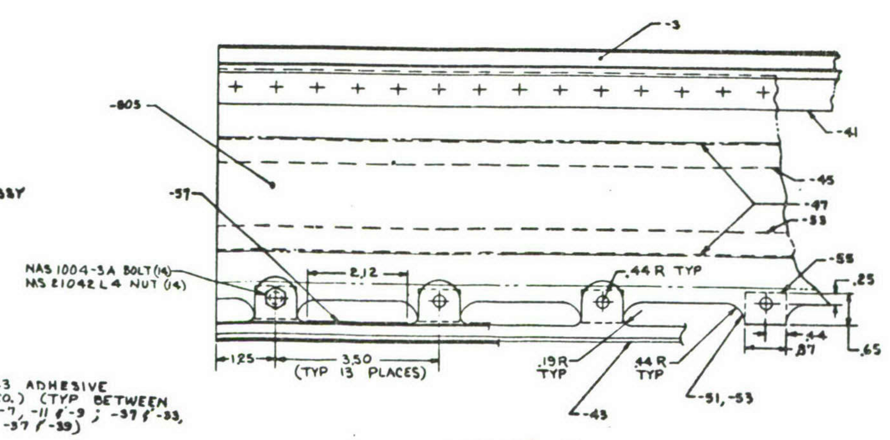


-1 ANALYTICAL ASSEMBLY
VIEW LOOKING DOWN AT
UPPER SURFACE
(CENTER SPAR STA 340.00)





DETAIL B
SCALE - NONE



SECT. A-A

TABLE I
-3 SKIN PANEL ASSEMBLY

DASH NO.	PART NAME	RAW STOCK SIZE	RAW STOCK WT.	MATERIAL	FINISHED STOCK SIZE	FINISHED WT. IN LBS.	NO. REQD
-7	INNER SKIN	.016 X 30.5 X 54.0	2.63	7050-T76 ALUMINUM ALLOY SHEET	.016 X 24.5 X 48.0	1.88	1
-9	OUTER SKIN	.016 X 30.4 X 54.0	2.62	7050-T76 ALUMINUM ALLOY SHEET	.016 X 24.4 X 48.0	1.87	1
-11	CORE	.025 X 85.7 X 54.0	11.56	7050-T76 ALUMINUM ALLOY SHEET	.025 X 79.7 X 48.0	9.55	1
-	ADHESIVE	30 SQ. FT.	-	AF 143 (3M)	-	3.00	AR
-	GLASS FABRIC	73 CU. IN.	-	181 STYLE IMPREGNATED WITH FMS1023 CLASS II RESIN	-	4.75	AR

TOTAL 21.05

TABLE II
-801 FRONT SPAR ASSEMBLY

DASH NO.	PART NAME	RAW STOCK SIZE	RAW STOCK WT.	MATERIAL	FINISHED STOCK SIZE	FINISHED WT. IN LBS.	NO. REQD
-13	SKIN	.016 X 4.8 X 54.0	.41	7050-T76 AL	.016 X 4.3 X 48.0	.33	2
-15	CORE	.300 X 3.8 X 54.0	.16	P006-1B	.264 X 3.3 X 48.0	.108	1
-17	SPAR CAP	2.85 X 3.15 X 54.0	48.46	7050-T76 AL	-	2.25	1
-19	SPAR CAP	2.70 X 1.65 X 54.0	24.05	7050-T76 AL	-	2.77	1
-	ADHESIVE	3.2 SQ. FT.	-	AF 143 (3M)	-	.32	AR

TOTAL 6.10

TABLE III
-803 REAR SPAR ASSEMBLY

DASH NO.	PART NAME	RAW STOCK SIZE	RAW STOCK WT.	MATERIAL	FINISHED STOCK SIZE	FINISHED WT. IN LBS.	NO. REQD
-23	SKIN	.016 X 4.5 X 54.0	.39	7050-T76 AL	.016 X 4.0 X 48.0	.30	2
-25	CORE	.300 X 3.5 X 54.0	.14	P006-1B	.264 X 3.0 X 48.0	.099	1
-27	SPAR CAP	1.80 X 2.95 X 54.0	28.60	7050-T76 AL	-	2.53	1
-29	SPAR CAP	1.75 X 2.95 X 54.0	27.80	7050-T76 AL	-	2.70	1
-	ADHESIVE	3.2 SQ. FT.	-	AF 143 (3M)	-	.32	AR

TOTAL 6.25

TABLE IV
-805 CENTER SPAR ASSEMBLY

DASH NO.	PART NAME	RAW STOCK SIZE	RAW STOCK WT.	MATERIAL	FINISHED STOCK SIZE	FINISHED WT. IN LBS.	NO. REQD
-45	EDGE MEMBER	.016 X 2.75 X 54.0	.237	7050-T76 AL	.016 X 2.25 X 48.0	.172	1
-47	SKIN	.016 X 2.85 X 54.0	.246	7050-T76 AL	.016 X 2.35 X 48.0	.180	1
-49	CORE	.400 X 4.10 X 54.0	.23	P006-1B	.331 X 3.6 X 48.0	.148	1
-51	SKIN	.016 X 5.75 X 54.0	.49	7050-T76 AL	.016 X 5.26 X 48.0	.39	1
-53	EDGE MEMBER	.016 X 2.45 X 54.0	.21	7050-T76 AL	.016 X 1.95 X 48.0	.14	1
-55	DOUBLER	.064 X .90 X 1.12	.006	7050-T76 AL	.064 X .65 X .87	.003	14
-	ADHESIVE	3.2 SQ. FT.	-	AF 143 (3M)	-	.32	AR

TOTAL 1.40

-1 ANALYTICAL ASSEMBLY - CONCEPT DATA SUMMARY 610RA106

DASH NO.	PART NAME	NO. REQD	RAW STOCK SIZE	RAW STOCK WT.	MATL	MATL. PROPS APPLICABLE TO CRIT STRESS	STATIC LIMIT DES STRESS (F_s 15.5/19.5)	MAX OPERATING STRESS	K_T	ALLOW FATIGUE STRESS	FRACT TOUGH	K_{ISCC}	DAM. TOL. CLASS	INSPECTABILITY CLASS	CRIT. CRACK LENGTH / TYPE	MIN. NDI DEFECT CRACK LENGTH / METH	ALLOW FRACT. STRESS	FIN. WEIGHT IN LBS.	COST IN DOLLARS
-3	SKIN PANEL ASSEMBLY	1	(SEE TABLE I)			F_{tu} = 62.5 ksi	F_t = 4.09 ksi (3.25)	3.25 ksi	—	—						.120/UT PEN	—	21.05	[illegible]
-5	SPAR-SKIN ASSEMBLY	1	(SEE TABLE V)			[illegible]										.180/UT PEN		33.67	556.2[illegible]
-805	CENTER SPAR ASSEMBLY	1	(SEE TABLE IV)			F_{tu} = 45.0 ksi	F_t = 14.71 ksi (11.69)	11.69 ksi	—	—						.07/PEN	—	1.40	28.71
-41	SPAR CAP	1	[illegible]	10.2	7050-T76 AL													.97	46.94
C556-6	INJ FTG	16																.07	12.32
C387V4-9	BOLT	196																1.50	86.24
C520-428-2	NUT	196																1.01	83.32
C623-4-9	BOLT	26																.20	20.54
C520-428-3	NUT	26																.15	10.14
MS20470AD3	RIVET	56																.03	1.12
NAS1004-3A	BOLT	14																.32	1.18
MS21042L4	NUT	14																.05	.28
				-5	Front Spar	F_{tu} = 45.0 ksi	F_t = 20.46 ksi (16.26)	16.26 ksi											
					Rear Spar	F_{tu} = 45.0 ksi	F_t = 14.28 ksi (11.59)	11.59 ksi											
					Low. Skin	F_{tu} = 70.0 ksi	F_t = 3.84 ksi (2.66)	2.66 ksi	1	57.8 ksi							40.0 ksi		
-1 ASSY	—																		733.53
																GRAND TOTAL		60.27	1631.24

TABLE V
-5 SPAR-SKIN ASSY

DASH NO.	PART NAME	RAW STOCK SIZE	RAW STOCK WT.	MATERIAL	FINISHED STOCK SIZE	FINISHED WT. IN LBS.	NO. REQD
-801	F S ASSY	SEE TABLE II			-	6.10	1
-803	R S ASSY	SEE TABLE III			-	6.25	1
-33	INNER SKIN	.016 X 18.1 X 54.0	1.54	7050-T76 AL	.016 X 12.1 X 48.0	.93	1
-35	INNER SKIN	.016 X 17.6 X 54.0	1.52		.016 X 11.6 X 48.0	.89	1
-37	CORE	.025 X 81.0 X 54.0	10.90		.025 X 75.0 X 48.0	9.00	1
-39	OUTER SKIN	.016 X 29.5 X 54.0	2.54		.016 X 23.50 X 48.0	1.80	1
-31	ANGLE	EXTR.	.31		.059 X 48.0	.28	1
-21	ANGLE	EXTR.	.31		.059 X 48.0	.28	1
-57	STRAP	.016 X 3.5 X 2.6	.02		.016 X 3.0 X 2.12	.01	13
-43	SPAR TEE	1.80 X 1.90 X 54.0	18.40	7050-T76 AL	-	.32	1
-	GLASS FABRIC	63 CU. IN.	-	181 STYLE IMPREGNATED WITH FMS1023 CLASS II RESIN	-	4.09	AR
-	ADHESIVE	30 SQ. FT.	-	AF 143 (3M)	-	3.00	AR

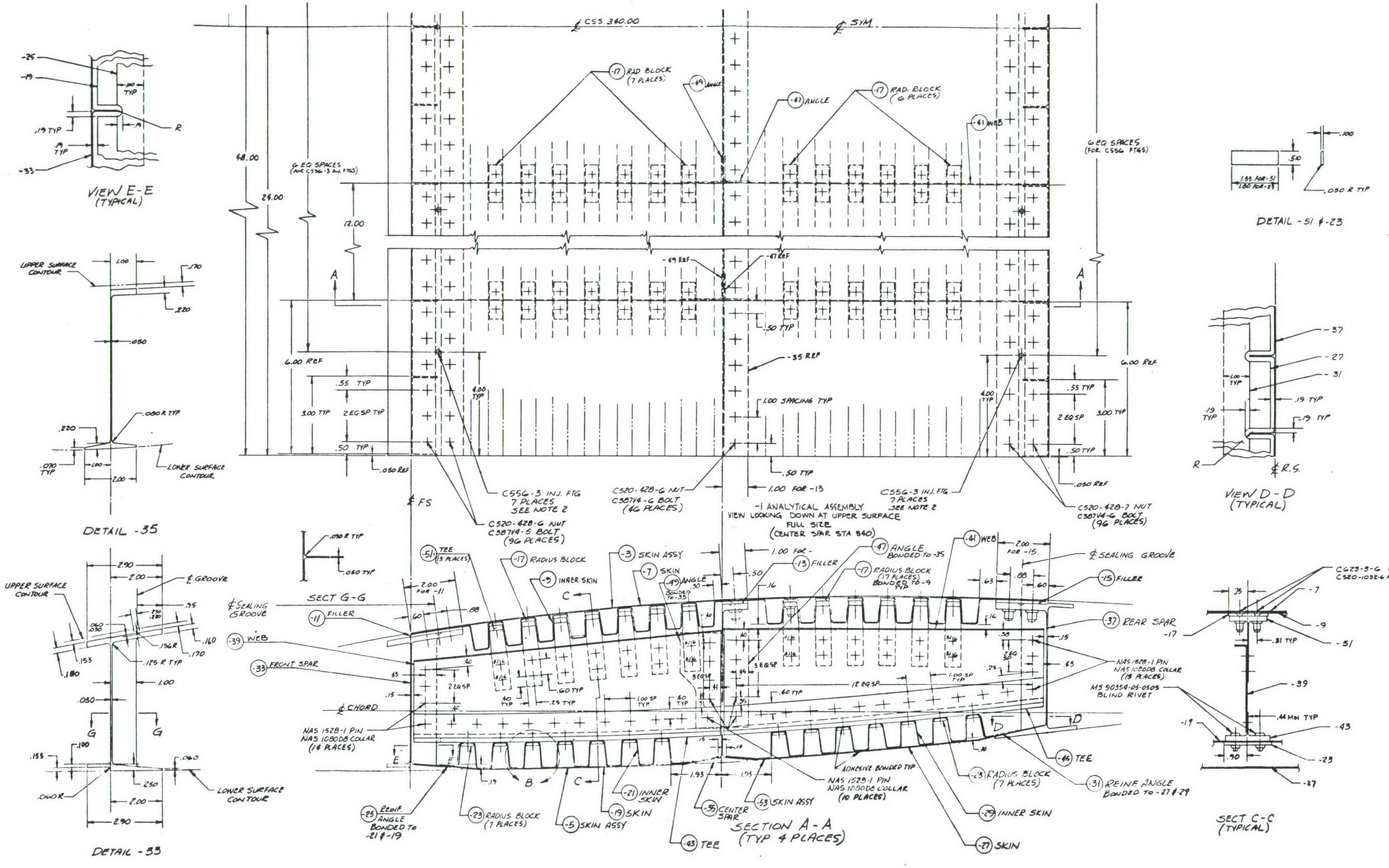
TOTAL 33.67

4. INSTALL C556 INJECTION FITTINGS PER M076 EQUALLY SPACED BETWEEN FASTENERS AS SHOWN AND CENTERED ON THE SEALING GROOVE. PLUG WITH NAS1081-06A3 SCREWS.
3. THE FAYING SURFACES AT THE FRONT AND REAR SPARS AND ALL FASTENERS SHALL BE SEALED PER FPS-1004.
2. USE AF143 ADH. (3M COMPANY) TO BOND -3, -5, -801, -803 & -805 ASSYS.
1. THE TRIANGULAR CORE DESIGN IS CONTINGENT UPON DEVELOPMENT OF AN ADHESIVE SYSTEM THAT WILL FORM FILLET AT THE CORE NODE INTERFACES AS SHOWN IN DETAIL B. ALTERNATE ADHESIVES THAT SHOULD PROVE SUCCESSFUL ARE:
   (A). APPLY FOAMING FMS1026 CLASS II AT THE CORE NODE INTERFACE.
   (B). APPLY 2 LAYERS OF AF143 (3M) IN THE CORE JOINT.
   (C). APPLY A BEAD OF AF143 ADHESIVE WITH A SEALANT GUN AT EACH CORE JOINT BEFORE BONDING.

NOTES:-

PRELIMINARY DESIGN DRAWING

ANALYTICAL ASSY - BONDED TRIANGULAR CORE, ALUMINUM; CSS 340	SCALE 1/1
GENERAL DYNAMICS Convair Aerospace Division Fort Worth Operation	610RA106



ANALYTICAL ASSY ~ CONCEPT DATA SUMMARY																		610RA107	
DASH NO.	PART NAME	NO. REQD	RAW STOCK SIZE	RAW STOCK WEIGHT	MAT'L	MAT'L PROPS APPLICABLE TO CRIT. STRESS	STATIC LIMIT DES STRESS (F x 1.5/1.5)	MAX. OPERATING STRESS	K_T	ALLOW FATIGUE STRESS	FRACT TOUGH	K_{ISCC}	DAM TOL. CLASS	INSPECTABILITY CLASS	CRIT. CRACK LENGTH / TYPE	MIN. NDI DETECT. CRACK LENGTH / METH	ALLOW. FRACT STRESS	FINISHED WEIGHT IN LBS	COST IN DOLLARS
-3	SKIN PANEL ASSY	1				-7→17 → -9→17 →	F=126 KSI (5.9) F=60.6 KSI	126 KSI 60.6 KSI	—	—						.150/PEN, UT, X-RAY		14.63	33.94
-5	SKIN PANEL ASSY	1				-21→25 → -19	F=42.7 KSI F=7.7 KSI	42.7 KSI 7.7 KSI								↓		4.93	16.21
-53	SKIN PANEL ASSY	1														.150/PEN, UT, X-RAY		5.30	16.58
	SEE TABLE II FOR ABOVE ASSYS																		
-33	FRONT SPAR	1	3X6X49	88.2	7050-T73 AL ALLOY											.100/PEN, UT		5.60	226.05
-35	CENTER SPAR	1	EXTRU X 49	85.7	7050-T73 AL ALLOY		F=30.3 KSI	30.3 KSI								↓		3.79	371.86
-37	REAR SPAR	1	3.5X6 X49	100.8	7050-T73 AL ALLOY											.100/PEN, UT		5.91	253.14
-39	WEB	1	SEE TABLE III FOR DETAILS													.07/PEN		.14	1.82
-41	WEB	1														.07/PEN		.15	1.84
-43	TEE	1																.45	2.32
-45	TEE	1																.51	2.48
-47	ANGLE	4																.096	1.62
-49	ANGLE	4																.112	1.63
-51	TEE	52																.884	7.26
NAS 1528-1		156	(PIN)															1.34	23.64
NAS 1080D8		156	(COLLAR)																3.12
MS 90354-05-0505		112	(BLIND RIV)															.625	38.08
MS 20470AD6		~	(RIVET)															—	
C387V4-6		142	(BOLT)															.852	79.52
C387V4-5		96	(BOLT)															.547	38.40
C520-1032-6		104	(NUT)															.364	52.00
C520-428-6		142	(NUT)															1.051	83.46
C520-428-7		96	(NUT)															.768	48.00
C556-3		14	(INJECT FTG)															.518	13.86
C623-3-6		104	(BOLT)															.353	38.48
																			793.30
																	TOTAL=	48.72	2172.61

TABLE III

DASH NO	PART NAME	RAW STOCK SIZE	RAW STOCK WT.	MATERIAL	FINISHED STOCK SIZE	FINISHED WT IN LBS
-39	WEB	.032X5X13	.20	7050-T76	.032X3.75X11.8	.14
-41	WEB	.032X5X13.5	.21	7050-T76	.032X3.75X12.5	.15
-43	TEE	EXTRU X 13	—	7050-T76511	.384IN²X11.80	.45
-45	TEE	EXTRU X14	—	7050-T76511	.384IN²X13.35	.51
-47	ANGLE	.032X2.5X5	.04	7050-T76	.032X2.0X4.75	.024
-49	ANGLE	.032X3.5X4.5	.05	7050-T76	.032X2.6X3.7	.028
-51	TEE	EXTRU X 1.0	—	7050-T76511	.253IN²X.50	.017

TABLE II
SKIN PANEL ASSY

ASSY NO	DASH NO	PART NAME	RAW STOCK SIZE	RAW STOCK WT	MATERIAL	FINISHED STOCK SIZE	FINISHED WT IN LBS	QUANTITY	TOTAL WT IN LBS	WT PER ASSY
-3	-7	SKIN	.032X25.5X49	3.99*	7050-T76	.032X24.5X48	3.76*	1	3.76	14.63
	-9	INNER SKIN	.032X54.0X49	8.46*	↕	.032X53.0X48	8.11*	1	8.11	
	-11	FILLER	.100X2.5X49	1.22*		.100X2.0X48	.96*	1	.96	
	-13	FILLER	.100X1.5X49	.73*		.100X1.0X48	.48*	1	.48	
	-15	FILLER	.100X2.5X49	1.22*		.100X2.0X48	.96*	1	.96	
	-17	RADIUS BLOCK	.100X1.0X2.0	.02*	7050-T76	.100X.50X1.65	.007*	52	.36	
-5	-19	SKIN	.020X12.5X49	1.22*	7050-T76	.020X11.75X48	1.04	1	1.04	4.93
	-21	INNER SKIN	.032X24.0X49	3.76*	↕	.032X22.9X48	3.50	1	3.50	
	-23	RADIUS BLOCK	.100X1.0X2.5	.03*		.100X.50X1.80	.01	28	.25	
	-25	REINF. ANGLE	.020X2.9X49	.23*	7050-T76	.020X1.85X48	.14	1	.14	
-53	-27	SKIN	.020X13.0X49	1.27*	7050-T76	.020X12.3X48	1.18	1	1.18	5.30
	-29	INNER SKIN	.032X25.0X49	3.92*	7050-T76	.032X24.0X48	3.68	1	3.68	
	-31	REINF ANGLE	.020X2.8X49	.27*	7050-T76	.020X2.30X48	.24	1	.24	
	-23	ANGLE	SEE ABOVE	.02*		SEE ABOVE	.007*	28	.20	

4. FAYING SURFACES BETWEEN UPPER SKIN ASSY & SPAR CAPS & FASTENERS SHALL BE SEALED PER FPS-1004.
3. USE AF 143 ADHESIVE (3M COMPANY) BETWEEN SKINS, INNER SKINS, RADIUS BLOCKS, BETWEEN LWR SKIN ASSYS & ALL SPAR CAPS, & BETWEEN VERTICAL ANGLES & WEBS.
2. INSTALL C556 INJECT FITTINGS PER MOTG EQUALLY SPACED BETWEEN FASTENERS AS SHN AND CENTERED ON THE SEALING GROOVE. PLUG WITH NAS 1081-06A3 SCREWS.
1. FORM -43 & -45 TEE TO MATCH LWR SURF CONTOUR. AS SHOWN

NOTES:

PRELIMINARY DESIGN DRAWING

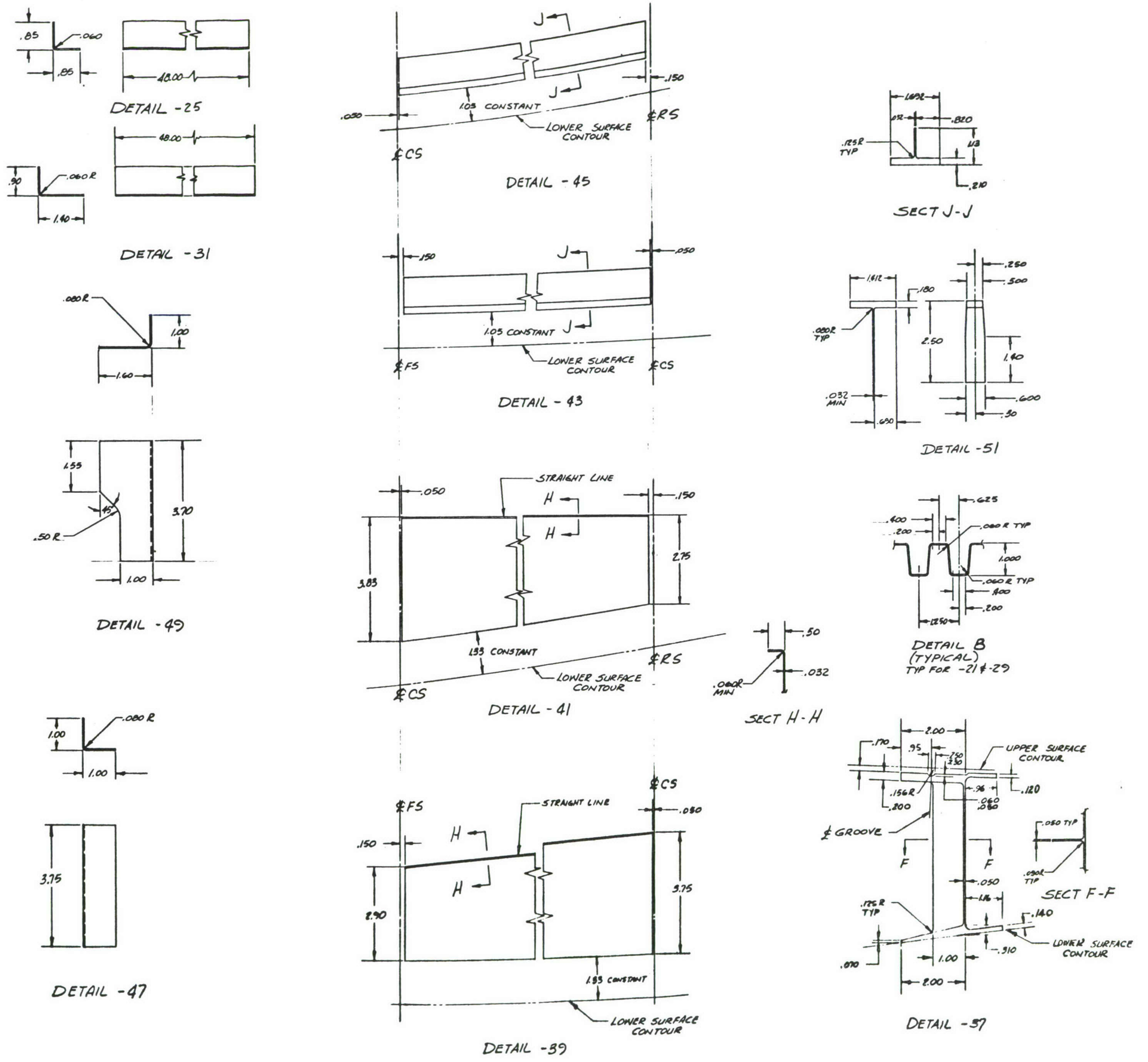
ANALYTICAL ASSY - ADHESIVE BONDED PANELS WITH CORRUGATED INNER SKIN (CSS 340.0)

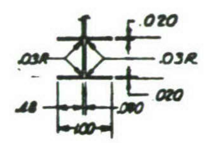
SCALE FULL

GENERAL DYNAMICS
Convair Aerospace Division
Fort Worth Operation

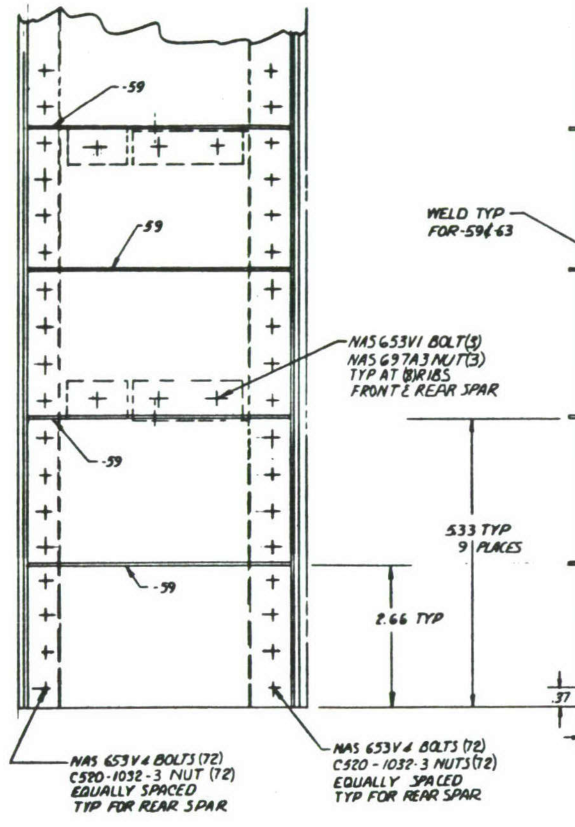
610RA107

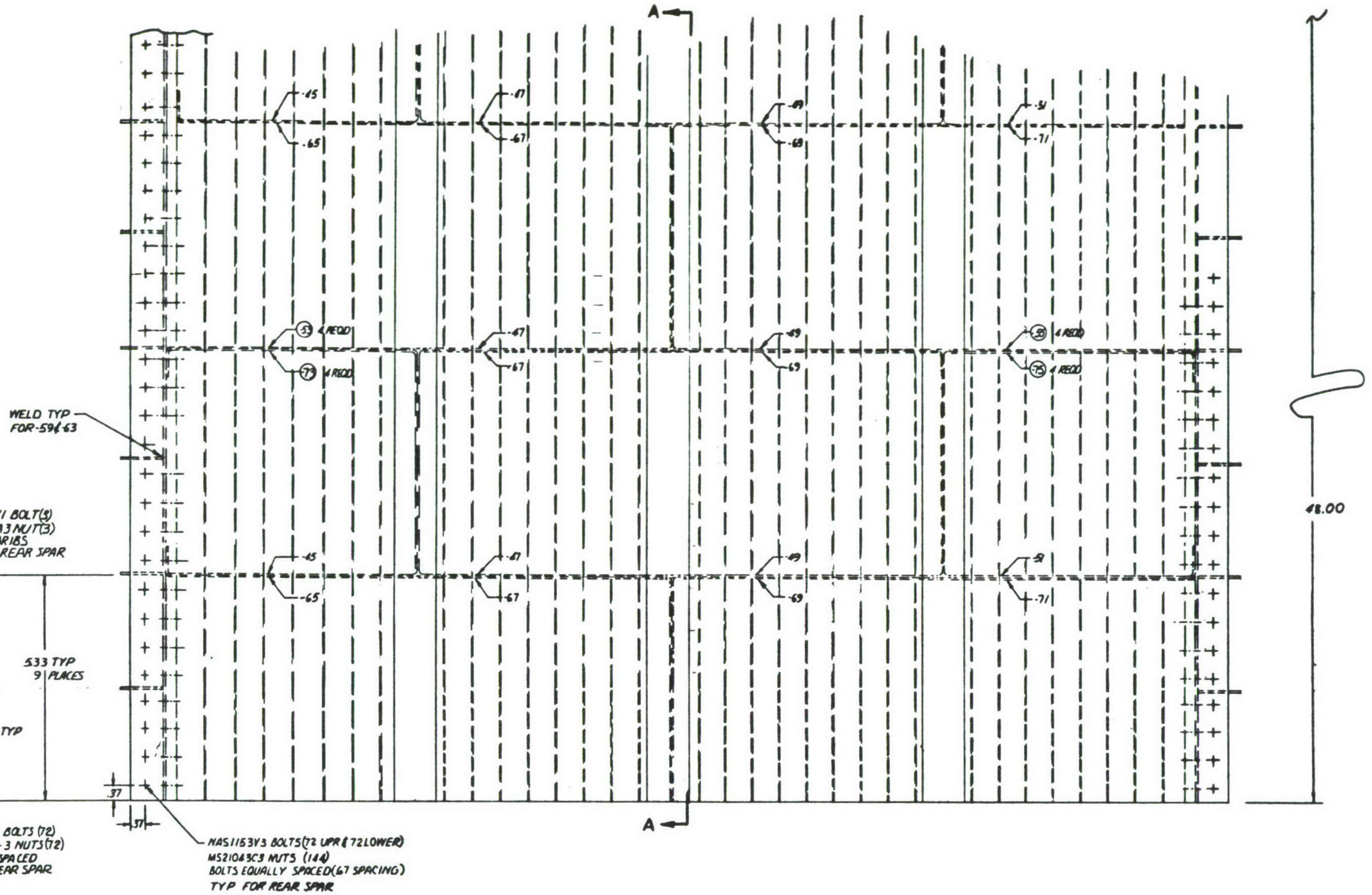
Sheet 1 367/368

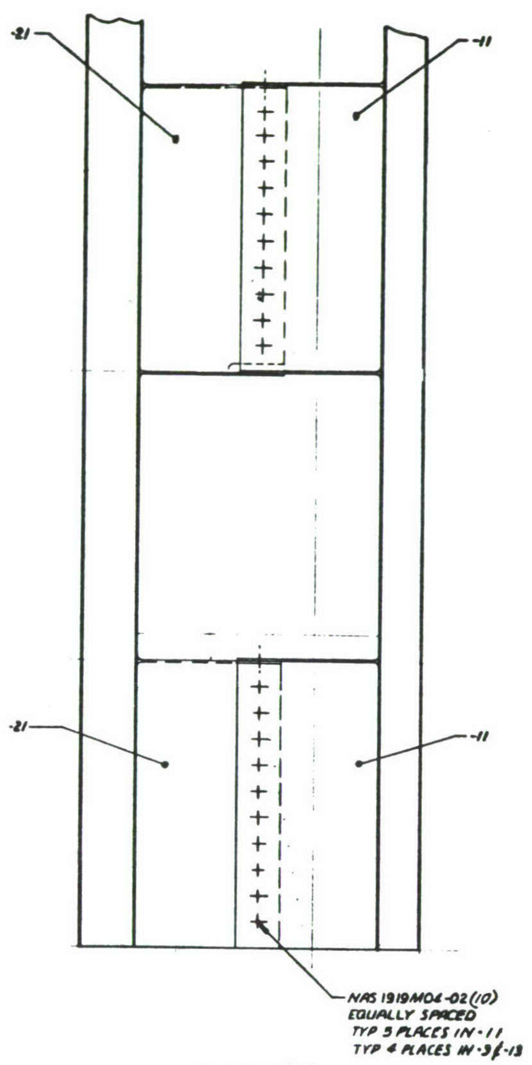

DETAIL -25
DETAIL -31
DETAIL -49
DETAIL -47
DETAIL - 45
DETAIL - 43
DETAIL - 41
DETAIL -39
SECT J-J
DETAIL -51
DETAIL B (TYPICAL) TYP FOR -21 & -29
SECT H-H
SECT F-F
DETAIL -37
LOWER SURFACE CONTOUR
UPPER SURFACE CONTOUR
STRAIGHT LINE
1.05 CONSTANT
1.35 CONSTANT



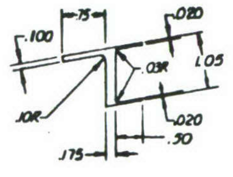
DETAIL - 9
DIMENSIONS SHOWN ARE TYP FOR -9, -11 & -13



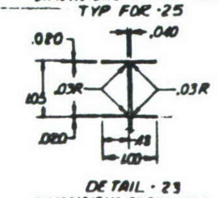




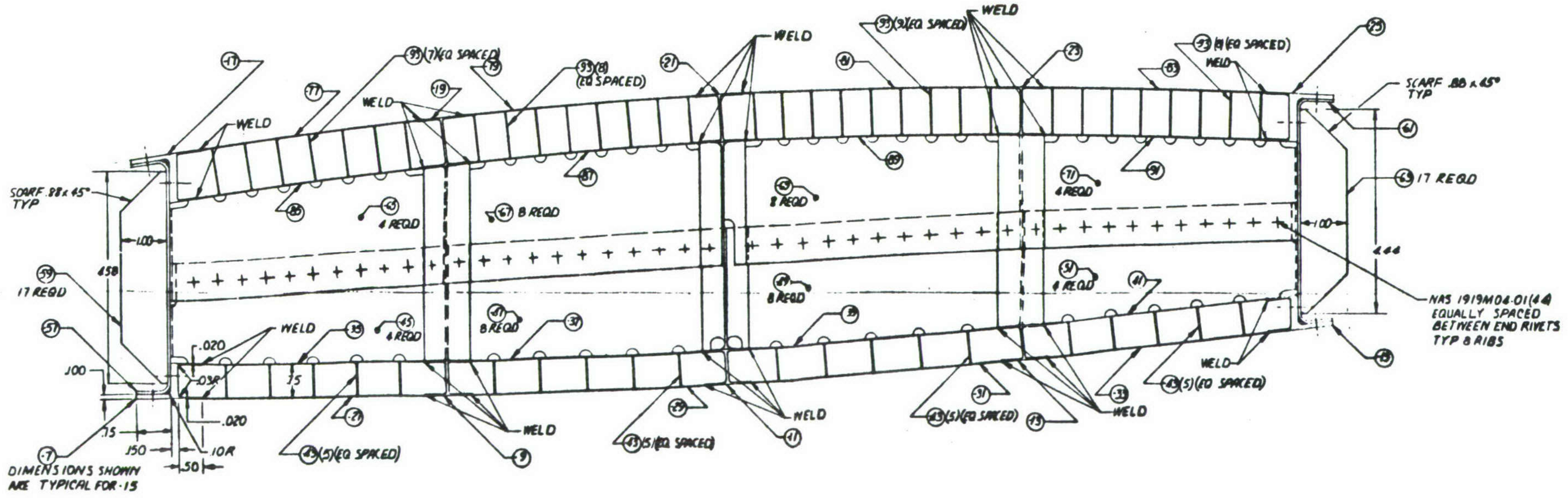
SECTION A-A



DETAIL - 17
DIMENSIONS SHOWN ARE TYP FOR -25



DETAIL - 23
DIMENSIONS SHOWN ARE TYP FOR -19, 21 & -23



ANALYTICAL ASSY ~ CONCEPT DATA SUMMARY — 61ORA108A

DASH NO.	PART NAME	NO. REQD	RAW STOCK SIZE	RAW STOCK WT	MATL	MATL PROPS APPLICABLE TO CRIT STRESS	STATIC LIMIT DES STRESS	MAX OPERATING STRESS	K_T	ALLOW FATIGUE STRESS	FRACT TOUGH K_{IC}	DAM TOL CLASS	INSPECTABILITY CLASS	CRIT CRACK LENGTH/TYPE	MIN NDI DETECT CRACK LENGTH/MIN	ALLOW FRACT STRESS	FINISH WT IN LBS	COST IN DOLLARS
-1	ANAL ASSY																(41.588)	
-3	LWR SKIN	1		(167.220)	ANNEALED 6Al-4V-Ti	F_{tu} = 134.0 KSI	F_t = 13.82 KSI (10.98)	10.98 KSI	3	40.0 KSI					.05/MIN	37.0 KSI	(13.968)	
-7	SPAR		2 x 1.52	16.64													1.611	
-9			1¼ x 4	41.60													.332	
-11			1⅛ x 4	41.60													.993	
-13			1¼ x 4	41.60													.77	
-15	SPAR		2 x 1	16.64													1.611	
-27	SKIN OTR		.016 x 7	.932													.894	
-29			8	1.065													.614	
-31			9	1.198													.678	
-33	OTR		8	1.065													.894	
-35	INR		7	.932													.894	
-37			8	1.065													.614	
-39			9	1.198													.678	
-41	SKIN INR	1	8	1.065													.594	
-43	STIFFENER	20	1 x .52	2.66													1.848	
-45	RIB	4	4 x 8	.328													.148	
-47		8	4 x 7	.576													.266	
-49		8	4 x 8	.656													.292	
-51		4	4 x 8	.328													.144	
-53		4	4 x 8	.328													.148	
-55	RIB	4	.016 x 4 x 8	.328													.144	
-5	UPR SKIN			(184.161)		F_{ty} = 132.0 KSI	F_t = 12.96 KSI (10.29)	10.29 KSI	—	—					.05/MIN	—	(12.068)	
-17	SPAR	1	2 x 1¼ x .52	20.80													2.091	
-19		1	1¼ x 4	41.60													.969	
-21		1	1⅛ x 4	41.60													.938	
-23		1	1¼ x 4	41.60													.946	
-25	SPAR	1	1¼ x 2 x .52	20.80													2.091	
-65	RIB	4	.016 x 8 x 4	.328													.154	
-67		8	8	.656													.271	
-69		8	8	.656													.296	
-71		4	8	.328													.148	
-73		4	7	.288													.154	
-75	RIB	4	8 x 4	.328													.148	
-77	SKIN OTR	1	7 x .52	.932													.602	
-79			8	1.065													.602	
-81			9	1.198													.688	
-83	OTR		8	1.065													.592	
-85	INR		7	.932													.602	
-87			7	.932													.602	
-89			8	1.065													.688	
-91	SKIN INR	1	.016 x 9	1.198													.592	
-93	STIFFENER	32	.021 x 2 x .52	6.660													3.004	
-801	FRONT SPAR			(4.434)		F_t = 79.0 KSI	F_t = 15.51 KSI (12.38)	12.38 KSI	—	—						—	(3.187)	
-57	SPAR	1	.050 x 8.6 x 52	3.578													2.534	
-59	STIFFENER	17	.063 x 1 x 5	.857													.653	
-803				(4.434)													(3.087)	
-61	SPAR	1	.050 x 8.6 x 52	3.578		F_t = 79.0 KSI	F_t = 11.75 KSI (9.34)	9.34 KSI	—	—						—	2.458	
-63	STIFFENER	17	.063 x 1 x 5	.857													.629	
	FASTENERS LESS HOLES																(3.278)	
	NAS653V4 BOLT	288		1.164														
	C520-1032-3 NUT			.740														
	NAS 1153V3 BOLT			.662														
	MS 21043C3 NUT	288		.518														
	NAS 653V2 BOLT	48		.178														
	NAS 697A3 NUT	48		.100														
	NAS 1919M04-01	352		.460														
	NAS 1919M04-02	90		.140														

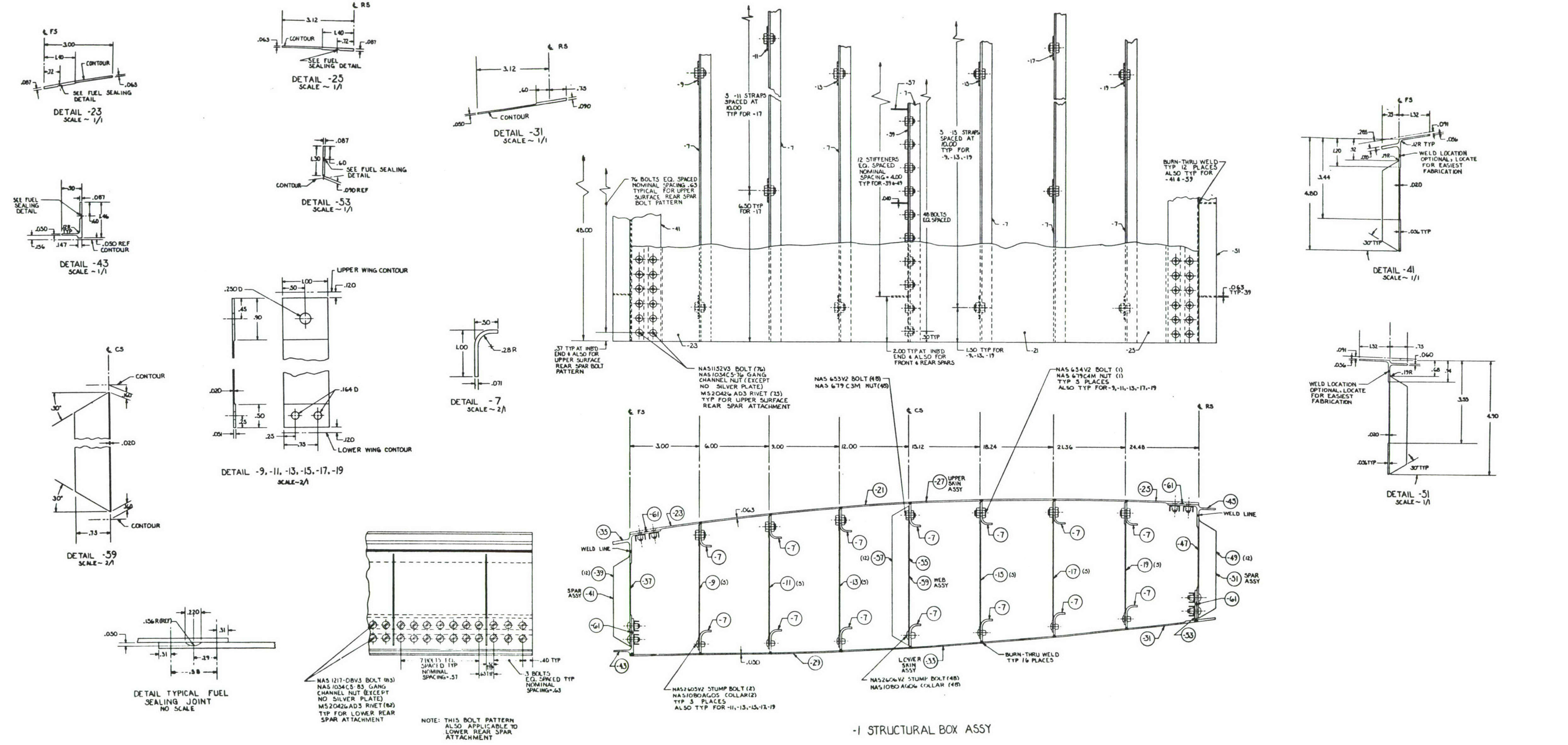
PRELIMINARY DESIGN DRAWING

ANALYTICAL ASSY - RECTANGULAR TUBE STIFFENED PANELS INTEGRAL SPAR CAP - CENTER SPAR STA 340

J.T. Pollard — DATE 1-20-73

GENERAL DYNAMICS
Convair Aerospace Division

61ORA108A



-1 ANALYTICAL ASSY ~ CONCEPT DATA SUMMARY																			61ORA109
PART NUMBER	PART NAME	Nº REQD	RAW STOCK SIZE	RAW STOCK WEIGHT	MAT'L	MATL PROPS APPLICABLE TO CRIT STRESS	STATIC LIMIT DES STRESS	MAX OPERATING STRESS	K_T	ALLOW FATIGUE STRESS	FRACT TOUGH	K_{Iscc}	DAM TOLER CLASS	INSPECTABILITY CLASS	CRIT CRACK LENGTH / TYPE	MIN NDI DETECT CRACK LENGTH / METH	ALLOW FRACT STRESS	FIN. WT. IN LBS	COST IN DOLLARS
-23	SKIN	1	[illegible]	2.16	6-4 Ti ANNEALED													1.63	42.42
-21	SKIN	1	[illegible]	13.06														8.88	139.46
-25	SKIN	1	[illegible]	2.23														1.64	43.16
-7	STRINGER	7	[illegible]	5.96														5.27	70.51
-27	UPPER SKIN ASSY	1		23.41			F: 14.4 ksi (11.4)	11.4 ksi								.07/PEN, X-RAY		17.42	—
-43	STRINGER	1	[illegible]	7.00														1.23	139.41
-29	SKIN	1	[illegible]	10.87														8.22	131.16
-31	SKIN	1	[illegible]	2.31														1.88	42.04
-53	STRINGER	1	[illegible]	3.64														.76	25.41
-7	STRINGER	7	[illegible]	5.96														5.27	70.51
-33	LOWER SKIN ASSY	1		29.28			F=6 ksi (4.75)	4.75 ksi								.07/PEN, X-RAY		12.36	—
-55	WEB	1	[illegible]	1.04														.92	22.81
-57	STIFFNER	12	[illegible]	.35														.32	16.63
-59	WEB ASSY	1		1.39												.04/PEN		1.24	—
-37	WEB	1	[illegible]	2.02														1.11	44.87
-39	STIFFENER	12	[illegible]	.36														.31	16.06
-35	CAP	1	[illegible]	5.88														1.37	131.91
-41	FRONT SPAR ASSY	1		8.26												.03/PEN		2.79	—
-47	WEB	1	[illegible]	2.24														1.14	47.63
-49	STIFFENER	12	[illegible]	.41														.34	16.59
-45	CAP	1	[illegible]	5.21														1.16	127.42
-51	REAR SPAR ASSY	1		7.86												.05/PEN, X-RAY		2.64	—
-9	TENSION STRAP	5	[illegible]	.25														.072	28.80
-11				.25														.077	28.80
-13				.25														.080	28.80
-15				.25														.080	28.80
-17				.25														.076	28.80
-19	TENSION STRAP	5	[illegible]	.25	6-4 Ti ANNEALED													.070	28.80
-61	SEALANT	AR			PMS-1044													.134	
NAS1152V3	BOLT	304			6-4 Ti													.538	212.80
NAS1217-08V3	BOLT	332																.908	249.00
NAS654V2	BOLT	30																.200	10.50
NAS653V2	BOLT	48			6-4 Ti													.187	12.00
NAS1034C5-76	GANG CHANNEL NUT	4			CRES													1.941	1.00
NAS1034C5-83	GANG CHANNEL NUT	4			CRES													1.994	1.00
NAS679C4M	NUT	30			CRES													.132	9.00
NAS679C3M	NUT	48			CRES													.134	14.40
NAS2605V2	STUMP BOLT	60			6-4 Ti													.085	60.00
NAS2606V2	STUMP BOLT	48			6-4 Ti													.099	56.16
NAS1080AG05	COLLAR	60			~~~													.020	9.00
NAS1080AG06	COLLAR	48			~~~													.020	7.20
MS20426AD3	RIVET	628			ALUM													.094	12.56
-1 ASSY																			706.32
															TOTAL			48.39	2661.74

PRELIMINARY DESIGN DRAWING

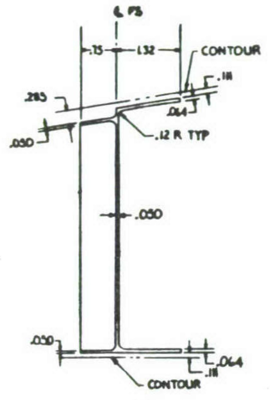
ANALYTICAL ASSY - MULTIPLE TENSION STRAP/WELDED STIFFENER PRESSURE CARRYING STRUCTURE; CSS 340

DATE 25 JAN 73

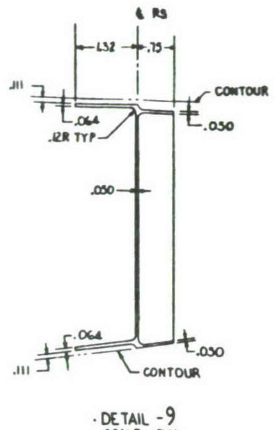
GENERAL DYNAMICS
Convair Aerospace Division
Fort Worth Operation

61ORA109

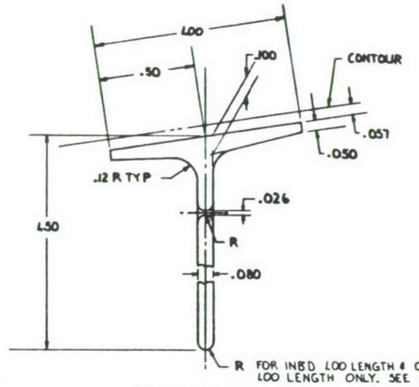
SHEET 1 OF 1



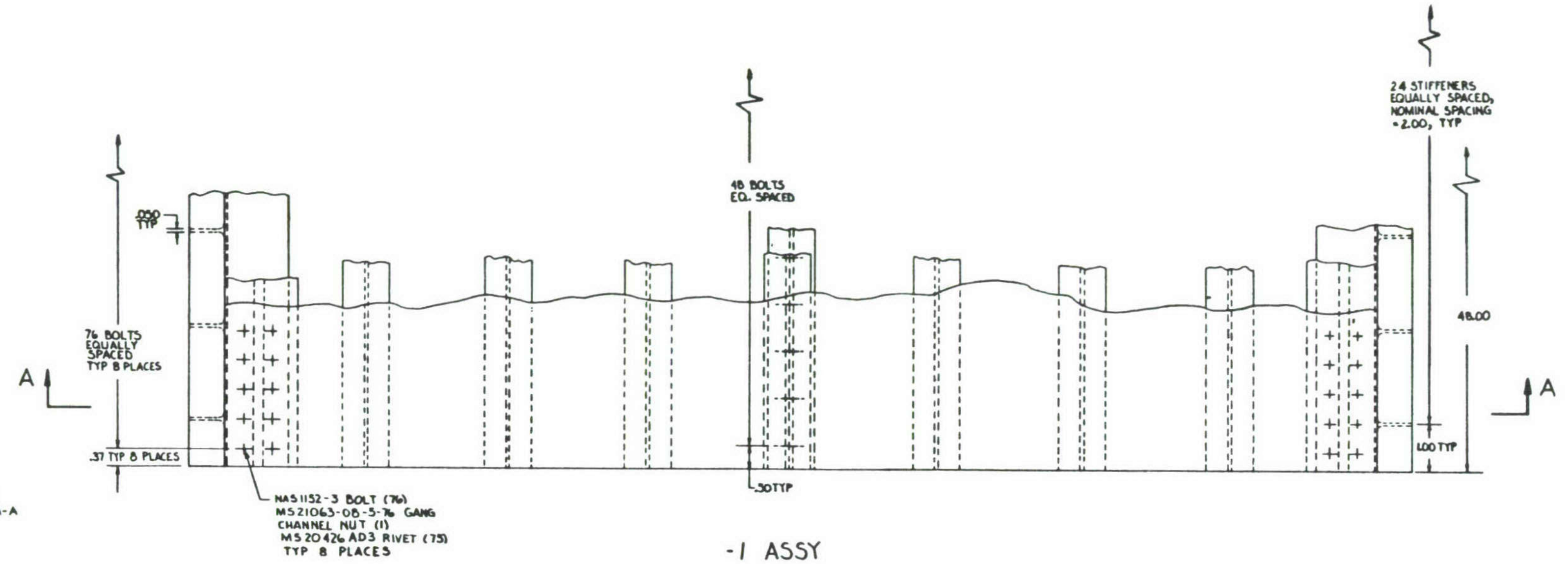
DETAIL -7
SCALE~FULL



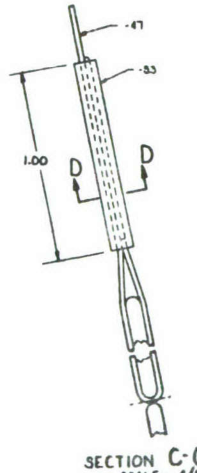
DETAIL -9
SCALE~FULL



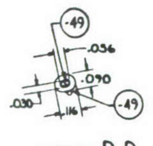
DETAIL -19, -21, -23, -25, -27, -29, -31, -33, -35, -37, -39, -41
SCALE~4/1
(CAP DETAILS APPLICABLE TO -43 & -45)



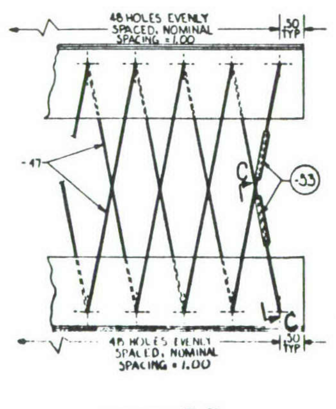
-1 ASSY



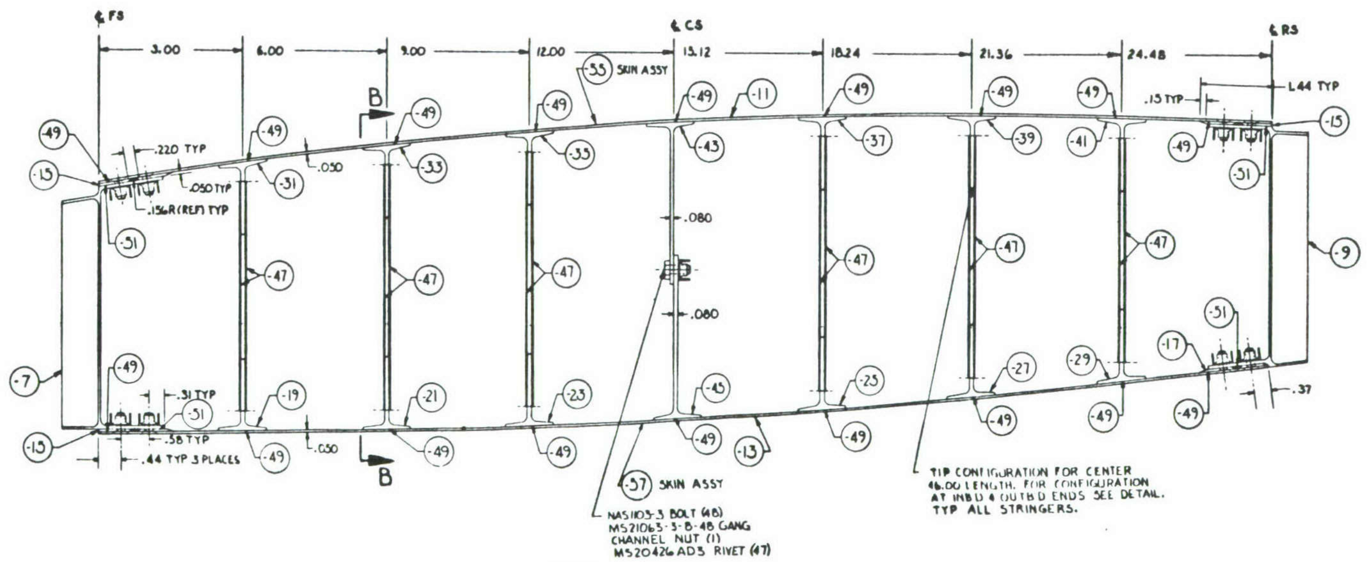
SECTION C-C
SCALE~4/1



SECTION D-D
SCALE~4/1



SECTION B-B
SCALE~FULL
WIRE LACING DETAILS
TYPICAL 6 PLACES



SECTION A-A
SCALE~FULL

ANALYTICAL ASSY ~ CONCEPT DATA SUMMARY																			610RA110
PART NUMBER	PART NAME	Nº REQD	RAW STOCK SIZE	RAW STOCK WEIGHT	MAT'L	MAT'L PROPS APPLICABLE TO CRIT. STRESS	STATIC LIMIT DES STRESS (F KSI / KSI)	MAX. OPERATING STRESS	K_T	ALLOW FATIGUE STRESS	FRACT TOUGH	K_{max}	DAM. TOL. CLASS.	INSPECT-ABILITY CLASS.	CRIT. CRACK LENGTH / TYPE	MIN NDI DETECT CRACK LENGTH / TYPE	ALLOW FRACT STRESS	FIN. WT. IN LBS.	COST IN DOLLARS
-7	FRONT SPAR	1	2.7x6.0x54	87.50	7050-T76 AL	F_y=41.5 KSI	F_t=13.09 KSI (10.40)	10.40 KSI	–	–						.15 UT, PEN	–	2.86	283.96
-9	REAR SPAR	1	2.7x6.0x54	87.50	↑	F_y=41.5 KSI	F=9.33 KSI (7.42)	7.42 KSI										2.84	284.00
-11	SKIN	1	.05x30x54	8.10														5.87	16.04
-15	SHIM	2	.05x2x49	.98														.64	12.81
-31	STRINGER	1	1.5x2x54	16.20		F_y=70 KSI TYP	F_T=6.89 KSI (5.47)	5.47 KSI	4.8	23.8 KSI							42.6 KSI	.94	51.64
-33				16.20														.94	51.61
-35				16.20														.94	51.64
-37				16.20														.94	51.64
-39				16.20														.94	51.64
-41	STRINGER	1	1.5x2x54	16.20														.94	51.64
-43	CENTER SPAR HALF	1	1.5x4x54	32.40	7050-T76 AL													1.67	103.96
-49	ADHESIVE	AR	—	—	AF 143 (3M Co)													.33	
-55	UPPER SKIN ASSY	1		138.68		F_y=62.5 KSI	F=8.18 KSI (6.50)	6.50 KSI	–	–						.15 UT, PEN	–	14.15	
-13	SKIN	1	.05x30x54	8.10	7050-T76 AL	F_{tu}=70 KSI	F=8.21 KSI (6.58)	6.58 KSI	1.0	37.3 KSI							25.0 KSI	5.87	16.04
-15	SHIM	1	.02x2x49	.49														.32	6.39
-17	SHIM	1	.02x2x49	.49														.32	6.39
-19	STRINGER	1	1.5x2x54	16.20														.94	51.64
-21				16.20														.94	51.64
-23				16.20														.94	51.64
-25				16.20														.94	51.64
-27				16.20														.94	51.64
-29	STRINGER	1	1.5x2x54	16.20														.94	51.64
-45	CENTER SPAR HALF	1	1.5x4x54	32.40	7050-T76 AL													1.67	103.76
-49	ADHESIVE	AR	—	—	AF 143 (3M Co)													.33	
-57	LOWER SKIN ASSY	1		138.68												.15 UT PEN		14.15	
-47	WIRE	AR	.024D x 3400	.44	STEEL	F_{tu}=350 KSI	F_T=183.47 NOTE 3 (KSI)											.40	
-53	COLLAR	24	—		ALUM CASTING													.02	24.00
-49	ADHESIVE	AR	—		AF 143 (3M Co)														
-51	SEALANT	AR	—		FMS-1044													.05	
NAS1152-3	BOLT	608	—		STEEL													1.91	24.32
MS21063-08-5-76	GANG CHANNEL NUT	8	—		NUT-STEEL CHANNEL-AL													2.23	.40
NAS1103-3	BOLT	48	—		STEEL													.40	.96
MS21063-3-8-48	GANG CHANNEL NUT	1	—		NUT-STEEL CHANNEL-AL													.23	.05
MS20426AD3	RIVET	647	—		AL													.10	12.94
-1 ASSY																			324.45
																TOTAL		39.34	2047.16

3. STRESS DUE TO FUEL PRESSURE
2. A "STRING" MADE FROM HIGH STRENGTH/HIGH MODULUS FIBROUS MATERIAL (SUCH AS DU PONT PRD 49 TYPE I) MAY BE SUITABLE AS A REPLACEMENT FOR THE -47 WIRE.
1. THIS DESIGN IS CONTIGENT UPON THE DEVELOPMENT & TESTING OF FABRICATION TECHNIQUES FOR "LACING" THE -47 WIRE.
NOTES:

PRELIMINARY DESIGN DRAWING
ANALYTICAL ASSY~DIAGONAL STEEL TENSION WIRE/ALUM PLATE STRINGER CONSTRUCTION; CSS 340
GENERAL DYNAMICS
Convair Aerospace Division
610RA110

SECTION III.4

COST AND WEIGHT WORKSHEETS

Dash No.	Raw Stock Weight	Finished Weight	Cost (In Dollars) Cost Breakdown		Total Cost
-7 Upper Skin	324.0	130.68	Mat'l Mfg	146.77 250.99	397.76
-9 Lower Skin	324.0	176.44	Mat'l Mfg	146.12 206.15	352.27
-11 Front Spar	220.59	19.25	Mat'l Mfg	275.74 258.56	534.30
-13 Fwd Aux Spar	91.58	11.62	Mat'l Mfg	53.39 132.02	185.41
-15 Center Spar	113.72	11.62	Mat'l Mfg	66.30 157.05	223.35
-17 Aft Aux Spar	99.36	11.08	Mat'l Mfg	57.93 142.02	199.95
-19 Rear Spar	141.75	12.42	Mat'l Mfg	71.87 186.16	258.03
-1 Assy			Mat'l Tooling Mfg	610.06 135.60 88.95	834.61
Total		384.89	Mat'l Tooling Mfg	1428.18 135.60 1421.90	2985.68

BASELINE CONFIGURATION - MACHINED ALUMINUM

610RA001

Dash No.	Raw Stock Weight	Finished Weight	Costs (in Dollars) Cost Breakdown		Total Cost
-7 Upper Skin	84.0	71.2	Mat'l Mfg	1581.10 31.60	1612.70
-9 Lower Skin	81.5	68.8	Mat'l Mfg	2146.98 3.08	2150.06
-11 Fwd Spar Uppr Cap	16.8	3.04	Mat'l Mfg	95.26 140.59	235.85
-13 Rear Spar Uppr Cap	15.3	2.08	Mat'l Mfg	86.75 135.07	221.82
-15 Fwd Spar Lwr Cap	7.18	1.86	Mat'l Mfg	40.71 62.01	102.72
-17 Rear Spar Lwr Cap	7.18	1.92	Mat'l Mfg	40.71 61.31	102.02
-19 Fwd Spar Web	1.65	1.39	Mat'l Mfg	30.20 1.07	31.27
-21 Rear Spar Web	1.71	1.57	Mat'l Mfg	35.06 1.07	36.13
-23 Multi-Cell Assy	52.0	37.8	Mat'l Mfg	526.24 217.18	743.42
-25 Angle	1.75	1.68	Mat'l Mfg	25.38 1.07	26.45
-27 Angle	1.61	1.55	Mat'l Mfg	23.35 1.07	24.42
Low Temp Braze Alloy	3.88	3.69	Mat'l	183.87	183.87
-1 Assy			Mat'l Tool. Mfg	 324.19 1420.39	1744.58
TOTAL		195.0	Mat'l Tool Mfg	4815.61 324.19 2075.51	7215.31

MULTI-WET CELL CONSTRUCTION - TITANIUM

Dash No.	Raw Stock Weight	Finished Weight	Costs (in Dollars)	
			Cost Breakdown	Total Cost
-7 Upp'r Panel	158.7	87.08	Mat'l - 1,590.00 Mfg - 160.87	1750.87
-9 Fwd Spar	78.6	11.53	Mat'l - 480.00 Mfg - 414.69	894.69
-11 Fwd Aux Spar	15.1	10.03	Mat'l - 189.00 Mfg - 58.40	247.40
-13 Center Spar	16.2	10.42	Mat'l - 206.00 Mfg - 58.40	264.40
-15 Aft Aux Spar	17.0	9.93	Mat'l - 220.00 Mfg - 58.40	278.40
-17 Aft Spar	29.2	9.08	Mat'l - 231.00 Mfg - 410.73	641.73
-19 Lower Panel	185.7	81.71	Mat'l - 2,208.00 Mfg. - 175.58	2383.58
-1 Assy			Mat'l - 252.00 Tool - 2,370.71 Mfg - 1,951.66	4574.37
TOTAL		219.78 Pounds	Mat'l - 5,376.00 Tool - 2,370.71 Mfg - 3,288.73	11,035.44

BRAZED SANDWICH SKINS WITH TRUSS MEMBER CORE
TITANIUM

Dash No	Raw Stock Weight	Finished Weight	Costs (in Dollars) Cost Breakdown	Total Cost
-7 Front Spar	246.19	15.09	Mat'l - 257.27 Mfg - 290.25	547.52
-9 Fwd Aux Spar	95.04	16.16	Mat'l - 265.16 Mfg - 131.35	396.51
-11 Center Spar	103.77	17.04	Mat'l - 289.52 Mfg - 140.76	430.28
-13 Aft Aux Spar	95.76	13.41	Mat'l - 267.17 Mfg - 135.97	403.14
-15 Rear Spar	249.50	9.87	Mat'l - 260.73 Mfg - 232.55	493.28
-3 Lower Panel	85.60	82.67	Mat'l - 119.76 Mfg - 499.49	619.25
-5 Upper Panel	213.71	116.49	Mat'l - 265.24 Mfg - 730.16	995.40
-55 Spar Cap	3.41	2.17	Mat'l - 9.51 Mfg - 6.17	15.68
-57 Spar Cap	3.73	2.45	Mat'l - 10.41 Mfg - 6.17	16.58
-59 Spar Cap	3.41	2.17	Mat'l - 9.51 Mfg - 6.17	15.68
-1 Assy		6.41	Mat'l - 334.25 Tool - 175.59 Mfg - 111.68	621.52
Total		283.93	Mat'l 2,088.53 Tool 175.59 Mfg 2,290.72	4554.84

LAMINATED LOWER AL SKIN WITH MACHINED STEPPED SPAR CAPS: BONDED H'COMB UPPER PANEL (AL)

610RA004

Dash No.	Raw Stock Weight	Finished Weight	Cost (in Dollars) Cost Breakdown		Total Cost
-3 Skin Panel Assy	213.71	113.12	Mat'l Mfg	257.49 730.16	987.65
-5 Beam Assy	11.10	6.95	Mat'l Mfg	145.45 82.33	227.78
-7 Beam Assy	13.643	6.87	Mat'l Mfg	179.83 102.40	282.23
-9 Beam Assy	15.411	8.71	Mat'l Mfg	201.34 99.81	301.15
-11 Beam Assy	13.225	7.82	Mat'l Mfg	172.02 99.81	271.83
-13 Beam Assy	14.23	6.83	Mat'l Mfg	190.94 96.02	286.96
-15 Skin Assy	19.74	18.05	Mat'l Mfg	224.37 118.28	342.65
-17 Skin Assy	17.65	18.03	Mat'l Mfg	231.31 118.28	349.59
-19 Skin Assy	15.59	17.27	Mat'l Mfg	208.76 119.04	327.80
-21 Skin Assy	11.41	10.56	Mat'l Mfg	163.28 118.28	281.56
-63 Spar Cap	3.41	2.17	Mat'l Mfg	6.34 6.17	12.51
-65 Spar Cap	3.73	2.45	Mat'l Mfg	6.94 6.17	13.11
-67 Spar Cap	3.41	2.17	Mat'l Mfg	6.34 6.17	12.51

(Continued)

ALUMINUM HONEYCOMB SANDWICH UPPER PANEL - TITANIUM BLADE STIFFENED PLANK LOWER

610RA004 (Continued)

Dash No.	Raw Stock Weight	Finished Weight	Cost (in Dollars) Cost Breakdown		Total Cost
-107 Angle	1.35	1.06	Mat'l Mfg	19.58 1.07	20.65
-109 Angle	1.73	1.46	Mat'l Mfg	25.09 1.07	26.16
-111 Angle	1.28	1.05	Mat'l Mfg	21.06 1.07	22.13
-113 Angle	1.62	1.32	Mat'l Mfg	23.45 1.07	24.56
-115 Angle	1.28	1.05	Mat'l Mfg	21.06 1.07	22.13
-117 Angle	1.28	1.05	Mat'l Mfg	21.06 1.07	22.13
-119 Angle	1.35	1.05	Mat'l Mfg	19.58 1.07	20.65
-121 Spar Cap	3.24	2.88	Mat'l Mfg	6.03 6.17	12.20
-123 Stiff	5.37	2.77	Mat'l Mfg	88.34 22.65	110.99
-125 Brace	22.62	1.086	Mat'l Mfg	142.05 124.48	266.53
-127 Brace	22.80	1.095	Mat'l Mfg	143.18 124.49	267.67
-129 Brace	23.61	1.137	Mat'l Mfg	148.27 124.49	272.76
-131 Brace	22.95	1.089	Mat'l Mfg	144.13 124.48	268.61
-133 Clip	.804	.288	Mat'l Mfg	92.45 2.31	94.76

(Continued)

ALUMINUM HONEYCOMB SANDWICH UPPER PANEL - TITANIUM BLADE STIFFENED PLANK LOWER

610RA004 (Continued)

Dash No.	Raw Stock Weight	Finished Weight	Cost (in Dollars)	
			Cost Breakdown	Total Cost
-1 Assy		19.00	Mat'l 359.89 Tooling 2132.90 Mfg 1934.02	4426.81
TOTAL		249.937	Mat'l 3269.67 Tooling 2132.90 Mfg 4173.50	9576.07

ALUMINUM HONEYCOMB SANDWICH UPPER PANEL - TITANIUM BLADE STIFFENED PLANK LOWER

Dash No.	Raw Stock Weight	Finished Weight	Cost (In Dollars)		
			Cost Breakdown		Total Cost
-3 Upper Skin Assy	150.02	119.26	Mat'l Mfg	166.05 25.81	191.86
-5 Lower Skin Assy	121.96	105.66	Mat'l Mfg	169.67 13.89	183.56
-87 Front Spar Assy	20.839	11.30	Mat'l Mfg	59.07 54.54	113.61
-89 Front Aux Spar Assy	17.664	13.38	Mat'l Mfg	51.68 54.32	106.00
-91 Center Spar Assy	18.042	13.74	Mat'l Mfg	52.99 54.32	107.31
-93 Aft Aux Spar	17.759	13.44	Mat'l Mfg	52.23 54.32	106.55
-95 Rear Spar Assy	30.057	13.29	Mat'l Mfg	85.03 54.54	139.57
-79 Beam	2.37	1.31	Mat'l Mfg	6.61 5.94	12.55
-81 Beam	2.37	1.31	Mat'l Mfg	6.61 5.94	12.55
-83 Beam	2.37	1.30	Mat'l Mfg	6.61 5.94	12.55
-85 Beam	2.37	1.30	Mat'l Mfg	6.61 5.94	12.55
-1 Assy		5.58	Mat'l Tooling Mfg	294.74 231.79 1493.39	2019.92
TOTAL		300.88	Mat'l Tooling Mfg	957.90 231.79 1828.89	3018.58

ADHESIVE BONDED LAMINATED LWR SKIN - HAT SIFF.
UPPER SKIN ALUMINUM

610RA006

DASH NO.	RAW STOCK WEIGHT	FINISHED WEIGHT	COST (IN DOLLARS)		
			COST BREAKDOWN		TOTAL COST
-3 Spar-Skin Assy	———	.12	Mat'l Mfg	——— 479.18	479.18
-801 Lwr Surf Assy	682.02	142.33	Mat'l Mfg	1036.70 762.11	1798.81
-803 Fwd Aux Spar Assy	12.12	8.91	Mat'l Mfg	34.02 26.62	60.64
-805 Center Spar Assy	12.53	9.49	Mat'l Mfg	35.16 26.63	61.79
-807 Aft Aux Spar Assy	11.94	8.79	Mat'l Mfg	33.51 26.62	60.13
-65 Upper Skin	202.5	122.82	Mat'l Mfg	236.32 132.68	369.00
-1 Assy		4.48	Mat'l Tooling Mfg	251.51 198.42 64.26	514.19
TOTAL		296.94	Mat'l Tooling Mfg	1627.22 198.42 1518.10	3343.74

LAMINATED LWR SKIN/STEPPED SPAR CAPS: PLATE UPPER SKIN
CORRUGATED SPAR WEBS - ALUMINUM

Dash No.	Raw Stock Weight	Finished Weight	Costs (in Dollars)	
			Cost Breakdown	Total Cost
-7 Upper Panel	92.72	79.49	Mat'l - 935.54 Mfg - 65.50	1,001.04
-9 Fwd Spar	15.44	10.01	Mat'l - 178.52 Mfg - 106.04	284.56
-11 Fwd Aux Spar	18.20	9.84	Mat'l - 238.08 Mfg. - 169.32	407.40
-13 Center Spar	19.98	10.51	Mat'l - 264.00 Mfg - 160.28	424.28
-15 Aft Aux Spar	18.99	9.89	Mat'l - 248.83 Mfg - 146.72	395.55
-17 Aft Spar	14.35	8.62	Mat'l - 178.82 Mfg. - 133.16	311.98
-19 Lower Panel	105.63	89.37	Mat'l - 1,648.02 Mfg. - 589.99	2238.01
-165 thru -187 RIB 1 thru RIB 12	2.83 each 33.96 total	2.37 each 28.44 total	Mat'l - 100.80 Mfg - 248.16	348.96
-1 Assy			Mat'l - 617.05 Tool - 1307.49 Mfg. - 2140.34	4064.88
TOTAL		246.17		9476.66

ADHESIVE BONDED LAMINATED SKINS WITH BONDED HAT STIFFENERS - TITANIUM

610RA008

Dash No.	Raw Stock Weight	Finished Weight	Costs (in Dollars) Cost Breakdown		Total Cost
-7 Upper Panel	58.41	47.79	Mat'l Mfg	1198.89 10.69	1209.58
-9 Lower Panel	39.45	38.61	Mat'l Mfg	613.14 8.55	621.69
-11 Fwd Spar	31.44	12.41	Mat'l Mfg	229.78 97.68	327.46
-13 Rear Spar	31.86	12.51	Mat'l Mfg	244.27 97.68	341.95
-15 Truss Assy	12.95	11.89	Mat'l Mfg	169.22 61.39	230.61
-17 Truss Assy	13.07	12.03	Mat'l Mfg	170.95 61.39	232.34
-19 Truss Assy	13.24	12.16	Mat'l Mfg	173.40 61.39	234.79
-21 Truss Assy	13.20	12.14	Mat'l Mfg	172.82 61.39	234.21
-23 Truss Assy	13.19	12.12	Mat'l Mfg	172.68 61.39	234.07
-25 Truss Assy	13.17	12.10	Mat'l Mfg	172.39 61.39	233.78
-27 Truss Assy	13.09	12.04	Mat'l Mfg	171.24 61.39	232.63
-29 Dia Tube	2.65	2.63	Mat'l Mfg	43.99 10.94	54.93
-1 Assy		2.51	Mat'l Tooling Mfg	620.80 8659.56 1498.76	10,779.12
TOTAL		200.94	Mat'l Tooling Mfg	4153.57 8659.56 2154.03	14,967.16

[illegible]R TUBE STIFFENED PANEL, INTEGRAL SPAR CAP,
[illegible]D SPAR - TITANIUM

610RA009

Dash No.	Raw Stock Weight	Finished Weight	Cost (in Dollars) Cost Breakdown	Total Cost
-45 Front Spar	238.10	14.85	Mat'l - 248.81 Mfg - 280.39	529.20
-47 Fwd Aux Spar	109.00	10.14	Mat'l - 304.11 Mfg - 153.47	457.58
-49 Center Spar	128.85	11.75	Mat'l - 359.49 Mfg. - 173.53	533.02
-51 Aft Aux Spar	115.14	9.95	Mat'l - 321.24 Mfg - 161.81	483.05
-53 Rear Spar	259.20	10.46	Mat'l - 270.86 Mfg - 305.39	576.25
-3 Skins & Adhesive	98.90	94.55	Mat'l - 133.13 Mfg. - 17.10	150.23
-5 Upper Skin	214.22	134.77	Mat'l - 241.86 Mfg - 157.40	399.26
-39	2.90	2.04	Mat'l - 8.09	8.09
-41	2.88	2.02	Mat'l - 8.04	8.04
-43	2.88	2.02	Mat'l - 8.04	8.04
-1 Assy		7.45	Mat'l - 395.32 Tool - 199.13 Mfg - 1030.23	1624.68
TOTAL		300.0	Mat'l - 2298.99 Tool - 199.13 Mfg - 2279.32	4777.44

MODIFIED TRIANGLE CORE, ADHESIVES BONDED ALUMINUM

Dash No.	Raw Stock Weight	Finished Weight	Cost (in Dollars) Cost Breakdown	Total Cost
-7 Upper Panel	182.3	120.35	Mat'l - 220.22 Mfg - 164.63	384.85
-9 Fwd Spar	14.76	8.353	Mat'l - 33.04 Mfg - 46.28	79.32
-11 Fwd Aux	11.35	8.037	Mat'l - 21.29 Mfg - 25.82	47.11
-13 Center Spar	11.758	8.192	Mat'l - 21.78 Mfg - 25.82	47.60
-15 Aft Aux Spar	11.708	7.999	Mat'l - 21.72 Mfg - 25.82	47.54
-17 Aft Spar	10.64	7.033	Mat'l - 21.66 Mfg - 25.71	47.37
-19 Lower Panel	207.779	133.096	Mat'l - 285.26 Mfg - 286.68	571.94
-1 Assy	--	--	Mat'l - 177.05 Tool - 240.66 Mfg - 1258.66	1676.37
TOTAL		293.06	Mat'l - 802.02 Tool - 240.66 Mfg - 1859.42	2902.10

ALUMINUM HONEYCOMB PANEL UPPR & LWR; INTEGRAL LWR SPAR CAPS
ADHESIVE BONDED

Dash No.	Raw Stock Weight	Finished Weight	Cost (in Dollars) Cost Breakdown		Total Cost
-7 Upper Panel	92.58	82.84	Mat'l	1425.39	1538.58
			Mfg	113.19	
-9 Lower Panel	117.49	84.48	Mat'l	1603.05	2095.46
			Mfg	492.41	
-11 Front Spar	18.03	9.53	Mat'l	192.33	277.09
			Mfg	84.76	
-13 Front Aux. Spar	17.83	8.80	Mat'l	226.50	275.86
			Mfg	49.36	
-15 Center Spar	22.27	9.54	Mat'l	238.33	287.69
			Mfg	49.36	
-17 Aft Aux. Spar	21.42	8.47	Mat'l	228.65	278.01
			Mfg	49.36	
-19 Rear Spar	22.73	10.64	Mat'l	222.54	296.57
			Mfg	74.03	
-127 Bhd	1.30	4.24	Mat'l	69.63	81.09
			Mfg	11.46	
-129 Bhd	1.46	5.00	Mat'l	77.90	89.36
			Mfg	11.46	
-131 Bhd	1.46	4.96	Mat'l	77.90	89.36
			Mfg	11.46	
-133 Bhd	1.39	4.68	Mat'l	77.90	89.36
			Mfg	11.46	
-151 Clip	2.70	.93	Mat'l	16.55	34.10
			Mfg	17.55	
-153 Clip	8.40	2.80	Mat'l	51.49	104.14
			Mfg	52.65	
-1 Assy		2.79	Mat'l	569.23	2810.08
			Tooling	456.86	
			Mfg	1783.99	
TOTAL		239.70	Mat'l	5077.39	8346.75
			Tooling	456.86	
			Mfg	2812.50	

BULBED TEE STIFFENED SKIN - TITANIUM

610RA012

Dash No.	Raw Stock Weight	Finished Weight	Cost (in Dollars) Cost Breakdown		Total Cost
-1 Fwd Aux Spar	19.675	8.274	Mat'l Mfg	205.73 122.87	328.60
-3 Center Spar	20.104	9.403	Mat'l Mfg	214.92 122.87	337.79
-5 Aft Aux Spar	20.104	8.819	Mat'l Mfg	215.10 122.87	337.97
-801 Front Spar	24.714	9.723	Mat'l Mfg	235.12 82.72	317.84
-803 Rear Spar	24.93	10.489	Mat'l Mfg	222.92 82.72	305.64
-805 Lower Skin	103.308	80.822	Mat'l Mfg	1425.22 554.96	1980.18
-807 Upper Skin	184.095	96.853	Mat'l Mfg	1909.08 891.55	2800.63
-809 Assy		15.54	Mat'l Tooling Mfg	212.64 331.62 90.16	634.42
TOTAL		239.92	Mat'l Tooling Mfg	4640.73 331.62 2070.72	7043.07

ADHESIVE BONDED HONEYCOMB SANDWICH SKINS AND SPAR WEBS
TITANIUM

610RA013

Dash No.	Raw Stock Weight	Finished Weight	Cost (In Dollars)	
			Cost Breakdown	Total Cost
-3 Skin Panel Assy	213.86	113.12	Mat'l 257.49 Mfg 730.16	987.65
-5 Beam Assy	17.031	7.76	Mat'l 136.40 Mfg 85.12	221.52
-7 Beam Assy	21.163	9.25	Mat'l 169.51 Mfg 105.19	274.70
-9 Beam Assy	22.161	10.37	Mat'l 178.46 Mfg 102.60	281.06
-11 Beam Assy	13.225	10.13	Mat'l 120.45 Mfg 102.60	223.05
-13 Beam Assy	20.595	8.13	Mat'l 171.02 Mfg 98.82	269.84
-15 Skin Assy	27.15	21.84	Mat'l 201.03 Mfg 118.28	319.31
-17 Skin Assy	26.52	21.92	Mat'l 197.55 Mfg 118.28	315.83
-19 Skin Assy	26.55	23.61	Mat'l 202.14 Mfg 119.04	321.18
-21 Skin Assy	23.05	13.17	Mat'l 174.76 Mfg 118.28	293.04
-63 Spar Cap	3.41	2.17	Mat'l 6.34 Mfg 6.17	12.51
-65 Spar Cap	3.73	2.45	Mat'l 6.94 Mfg 6.17	13.11
-67 Spar Cap	3.41	2.17	Mat'l 6.34 Mfg 6.17	12.51
-121 Spar Cap	3.24		Mat'l 6.03 Mfg 6.17	12.20

(Continued)

ALUMINUM HONEYCOMB SANDWICH UPPER PANEL-BLADE STIFFENED PLANK LOWER - 6A1-4V TITANIUM

610RA013

Dash No.	Raw Stock Weight	Finished Weight	Cost (In Dollars)	
			Cost Breakdown	Total Cost
-123 Stiff	5.37	2.87	Mat'l 67.39 Mfg 22.65	90.04
-125 Brace	22.62	1.11	Mat'l 107.45 Mfg 124.48	231.93
-127 Brace	22.80	1.12	Mat'l 131.10 Mfg 124.49	255.59
-129 Brace	23.61	1.16	Mat'l 135.76 Mfg 124.49	260.25
-131 Brace	22.95	1.13	Mat'l 131.96 Mfg 124.48	256.44
-133 Clip		.45	Mat'l 70.53 Mfg 2.31	72.84
-1 Assy			Mat'l 359.89 Tooling 596.45 Mfg 1080.08	2036.42
TOTAL		267.36	Mat'l 2838.54 Tooling 596.45 Mfg 3326.03	6761.02

ALUMINUM HONEYCOMB SANDWICH UPPER PANEL BLADE
STIFFENED PLANK LOWER - 6Al-4V TITANIUM

DRAWING 610RA100

Dash No.	Raw Stock Weight	Finished Weight	Cost (In Dollars)		
			Cost Breakdown		Total Cost
-7 Upper Skin	65.7	20.69	Mat'l Mfg	42.23 89.56	131.79
-9 Lower Skin	65.7	17.87	Mat'l Mfg	42.23 93.15	135.38
-11 Front Spar	123.0	7.31	Mat'l Mfg	91.90 171.43	263.33
-13 Fwd Aux Spar	52.5	3.38	Mat'l Mfg	36.39 94.27	130.66
-15 Center Spar	56.7	3.37	Mat'l Mfg	39.30 100.10	139.40
-17 Aft Aux Spar	52.5	3.64	Mat'l Mfg	36.39 94.46	130.85
-19 Rear Spar	81.0	5.75	Mat'l Mfg	56.14 127.43	183.57
-1 Assy		7.16	Mat'l Tooling Mfg	456.60 106.83 167.60	731.03
Total		69.17	Mat'l Tooling Mfg	801.18 106.83 938.00	1846.01

BASELINE CONFIGURATION, MACHINED ALUMINUM

Dash No.	Raw Stock Weight	Finished Weight	Cost (In Dollars) Cost Breakdown	Total Cost
-3 Spar-Skin Assy	--	--	Mat'l Mfg 326.70	
-7 Front Spar	100.00	4.27	Mat'l 104.50 Mfg 149.96	254.46
-9 Rear Spar	99.30	4.75	Mat'l 103.77 Mfg 148.12	251.89
-11 Doubler	2.41	2.04	Mat'l 3.62 Mfg 1.13	4.75
-13 Doubler	.13	.096	Mat'l .26 Mfg 1.11	1.37
-15 Doubler	.10	.065	Mat'l .20 Mfg 7.24	7.44
-17 Doubler	.14	.098	Mat'l .28 Mfg 3.10	3.38
-19 Doubler	.17	.129	Mat'l .34 Mfg 3.10	3.44
-21 Doubler	.21	.177	Mat'l .42 Mfg 1.03	1.45
-23 Doubler	.18	.139	Mat'l .36 Mfg 1.11	1.47
-25 Hat	2.40	.800	Mat'l 2.65 Mfg 6.18	8.83
-27 Hat	2.76	.888	Mat'l 3.04 Mfg 1.54	4.58
-29 Hat	2.56	.840	Mat'l 2.82 Mfg 1.54	4.36
-31 Hat	2.70	.874	Mat'l 2.98 Mfg 1.54	4.52
-51 Rib Web	.21	.128	Mat'l .32 Mfg 2.37	2.69
-53 Rib Web	.20	.121	Mat'l .30 Mfg 2.37	2.67

B-20
III-69

ADHESIVE BONDED HAT STIFFENERS, ALUMINUM (Cont'd)

610RA101 (Cont'd)

Dash No.	Raw Stock Weight	Finished Weight	Cost (In Dollars)	
			Cost Breakdown	Total Cost
-55 Support	.84	.250	Mat'l .93 Mfg 34.87	35.80
-57 Support	.88	.265	Mat'l .97 Mfg 34.88	35.85
-59 Support	.06	.039	Mat'l .08 Mfg. 4.26	4.34
-61 Support	.06	.037	Mat'l .08 Mfg 4.26	4.34
-63 Stiff	.05	.035	Mat'l .06 Mfg 8.56	8.62
-64 Stiff	.05	.035	Mat'l .06 Mfg 1.07	1.13
-65 Stiff	.03	.017	Mat'l .04 Mfg 1.07	1.11
-67 Center Spar Web	.92	.691	Mat'l 1.38 Mfg 2.13	3.51
-69 Spar Cap	5.40	.613	Mat'l 5.68 Mfg 33.92	39.60
-33 Doubler	.72	.520	Mat'l .79 Mfg 1.78	2.57
-35 Doubler	.85	.650	Mat'l .94 Mfg 8.97	9.91
-37 Doubler	.75	.550	Mat'l .83 Mfg 1.78	2.61
-39 Doubler	.77	.570	Mat'l .85 Mfg 1.78	2.63
-5 Skin Panel Assy		16.26	Mat'l 44.93 Mfg 38.68	83.61
Adhesive		2.26	Mat'l 11.30 Mfg	11.30

(Cont'd)

ADHESIVE BONDED HAT STIFFENERS, ALUMINUM

610RA101 (Cont'd

Dash No.	Raw Stock Weight	Finished Weight	Cost (In Dollars) Cost Breakdown		Total Cost
-1 Assy		4.278	Mat'l Tooling Mfg	491.76 230.49 620.42	1342.67
TOTAL		51.12	Mat'l Tooling Mfg	786.54 230.49 1129.87	2146.90

ADHESIVE BONDED HAT STIFFENERS, ALUMINUM

Dash No.	Raw Stock Weight	Finished Weight	Cost (in Dollars) Cost Breakdown	Total Cost
-7 Upper Panel	9.868	9.371	Mat'l - 29.96 Mfg - 9.78	39.74
-9 Fwd Spar	55.19	5.914	Mat'l - 58.29 Mfg - 53.03	111.32
-11 Fwd Aux Spar	50.786	4.938	Mat'l - 54.12 Mfg - 70.62	124.74
-13 Aft Aux Spar	50.786	4.916	Mat'l - 54.12 Mfg - 70.62	124.74
-15 Aft Spar	55.19	5.906	Mat'l - 58.38 Mfg - 53.03	111.41
-17 Lower Panel	9.58	8.794	Mat'l - 29.47 Mfg - 19.51	48.98
-1 Assy	12.626	--	Mat'l - 838.66 Tool - 199.23 Mfg - 1114.18	2152.07
TOTAL	--	39.83	Mat'l - 1123.00 Tool - 199.23 Mfg. - 1390.77	2713.00

SANDWICH SKIN PANELS, INTEGRAL LOWER SPAR CAPS (A1.)

Dash No.	Raw Stock Weight	Finished Weight	Cost (In Dollars) Cost Breakdown		Total Cost
-7 Interior Spar-Half	.63	.362	Mat'l Mfg	1.27 1.10	2.37
-9 Interior Spar-Half	.63	.362	Mat'l Mfg	1.27 1.10	2.37
-11 Interior Spar-Half	.63	.342	Mat'l Mfg	1.27 1.10	2.37
-13 Interior Spar-Half	.63	.342	Mat'l Mfg	1.27 1.10	2.37
-15 Interior Spar-Half	.71	.360	Mat'l Mfg	1.43 1.10	2.53
-17 Interior Spar-Half	.71	.360	Mat'l Mfg	1.43 1.10	2.53
-19 Interior Spar-Half	.71	.356	Mat'l Mfg	1.43 1.10	2.53
-21 Interior Spar-Half	.71	.356	Mat'l Mfg	1.43 1.10	2.53
-23 Interior Spar-Half	.71	.351	Mat'l Mfg	1.43 1.10	2.53
-25 Interior Spar-Half	.71	.351	Mat'l Mfg	1.43 1.10	2.53
-27 Interior Spar-Half	.71	.349	Mat'l Mfg	1.43 1.10	2.53
-29 Interior Spar-Half	.71	.349	Mat'l Mfg	1.43 1.10	2.53
-31 Interior Spar-Half	.71	.352	Mat'l Mfg	1.43 1.10	2.53
-33 Interior Spar-Half	.71	.351	Mat'l Mfg	1.43 1.10	2.53
-35 Interior Spar-Half	.71	.354	Mat'l Mfg	1.43 1.10	2.53
-37 Interior Spar-Half	.71	.354	Mat'l Mfg	1.43 1.10	2.53

(Continued)

B-24

III-63 ADHESIVE BONDED, CLOSE SPAR SPACING - ALUMINUM

Dash No.	Raw Stock Weight	Finished Weight	Cost (In Dollars) Cost Breakdown		Total Cost
-39 Interior Spar- Half	.63	.351	Matl Mfg	1.27 1.10	2.37
-41 Interior Spar-Half	.63	.351	Mat'l Mfg	1.27 1.10	2.37
-43 Interior Spar-Half	.63	.350	Mat'l Mfg	1.27 1.10	2.37
-45 Interior Spar-Half	.63	.350	Mat'l Mfg	1.27 1.10	2.37
-47 Interior Spar-Half	.63	.365	Mat'l Mfg	1.27 1.10	2.37
-49 Interior Spar-Half	.63	.365	Mat'l Mfg	1.27 1.10	2.37
-51 Front Spar	84.24	2.716	Mat'l Mfg	88.03 134.60	222.63
-53 Rear Spar	81.43	2.776	Mat'l Mfg	85.09 130.98	216.07
-55 Lower Skin	1.88	1.259	Mat'l Mfg	3.78 1.01	4.79
-57 Upper Skin	1.88	1.261	Mat'l Mfg	3.78 1.01	4.79
-59 Skin	.52	.387	Mat'l Mfg	1.05 4.06	5.11
-61 Skin	2.80	2.120	Mat'l Mfg	5.63 20.28	25.91
-63 Shim		1.104	Mat'l Mfg	.10	.10
-65 Adhesive		5.400	Mat'l Mfg	27.00	27.00
-1 Assy			Mat'l Tooling Mfg	 212.22 1279.33	1491.55
TOTAL		24.807	Mat'l Tooling Mfg	244.22 212.22 1595.57	2052.01

ADHESIVE BONDED, CLOSE SPAR SPACING - ALUMINUM

Dash No.	Raw Stock Weight	Finished Weight	Cost (In Dollars) Cost Breakdown		Total Cost
-15 Upper Skin	5.27	3.76	Mat'l	6.66	7.73
			Mfg	1.07	
-17 Inner Skin	6.66	5.35	Mat'l	11.99	17.19
			Mfg	5.20	
-19 Doubler	.78	.54	Mat'l	.90	1.97
			Mfg	1.07	
-21 Doubler	.47	.27	Mat'l	.54	1.61
			Mfg	1.07	
-23 Doubler	.76	.53	Mat'l	.87	1.94
			Mfg	1.07	
-25 Doubler	.01	.006	Mat'l	.01	8.35
			Mfg	8.34	
-3 Skin Panel Assy		1.49	Mat'l	——	——
			Mfg	——	
-7 Rib		.187	Mat'l	4.21	4.21
			Mfg		
-9 Rib		.223	Mat'l	5.03	5.03
			Mfg		
-11 Rib		.48	Mat'l	1.08	1.08
			Mfg		
-13 Rib		.44	Mat'l	.99	.99
			Mfg	——	
-27 Rear Spar	99.30	5.24	Mat'l	103.77	252.44
			Mfg	148.67	
-29 Center Spar	80.19	2.11	Mat'l	83.80	213.82
			Mfg	130.02	
-31 Front Spar	100.00	5.41	Mat'l	104.50	252.67
			Mfg	148.17	

(Continued)

INTEGRAL FORMED BULBED TEE, ALUMINUM

610RA104 (Cont'd)

Dash No.	Raw Stock Weight	Finished Weight	Cost (In Dollars) Cost Breakdown	Total Cost
-33 Inner Skin	2.85	2.07	Mat'l 5.74 Mfg 2.98	8.72
-35 Outer Skin	1.53	.91	Mat'l 3.08 Mfg 3.29	6.37
-37 Inner Skin	3.09	2.29	Mat'l 6.22 Mfg 1.07	7.29
-39 Outer Skin	1.55	.92	Mat'l 3.12 Mfg 1.07	4.19
-41 Spar Cap	7.83	.46	Mat'l 10.27 Mfg 14.99	25.26
-43 Angle	.90	.055	Mat'l .95 Mfg 19.28	20.23
-45 Angle	.70	.022	Mat'l .74 Mfg 19.27	20.01
-5 Spar Skin Assy		1.62	Mat'l 28.23 Mfg	28.23
-1 Assy			Mat'l 989.59 Tooling 188.49 Mfg 555.46	1733.54
TOTAL		40.75	Mat'l 1372.29 Tooling 188.49 Mfg 1062.09	2622.89

INTEGRAL FORMED BULBED TEE, ALUMINUM

Dash No.	Raw Stock Weight	Finished Weight	Cost (In Dollars) Cost Breakdown		Total Cost
-7 Upper Skin	10.3	7.53	Mat'l	129.27	130.34
			Mfg	1.07	
-9 Lower Skin	10.3	7.93	Mat'l	129.27	130.34
			Mfg	1.07	
-11 Front Spar Assy	——	——	Mat'l	——	21.45
			Mfg	21.45	
-13 Upper Cap	10.4	1.36	Mat'l	63.75	111.72
			Mfg	47.97	
-15 Wed	.72	.68	Mat'l	11.95	13.02
			Mfg	1.07	
-17 Lower Cap	10.4	1.36	Mat'l	63.75	111.72
			Mfg	47.97	
-19 Rear Spar Assy	——	——	Mat'l	——	21.45
			Mfg	21.45	
-21 Upper Cap	10.4	1.36	Mat'l	63.75	111.72
			Mfg	47.97	
-23 Web	.72	.66	Mat'l	11.95	13.02
			Mfg	1.07	
-25 Lower Cap	8.00	.91	Mat'l	49.04	97.01
			Mfg	47.97	
-27 Web Assy	12.55	10.35	Mat'l	127.01	230.41
			Mfg	103.40	
-29 Angle	1.50	1.15	Mat'l	18.83	23.48
			Mfg	4.65	
-1 Assy	.75	.68	Mat'l	35.25	2789.96
			Tooling	2127.87	
			Mfg	626.84	
Total		33.97	Mat'l	703.82	3805.64
			Tooling	2127.87	
			Mfg	973.95	

Multi-Wet Cell Construction - Titanium

610RA106

Dash No.	Raw Stock Weight	Finished Weight	Cost(In Dollars)	
			Cost Breakdown	Total Cost
-3 Skin Panel Assy	24.56	21.05	Mat'l 44.53 Mfg 12.63	57.16
-5 Spar Skin Assy	165.55	33.67	Mat'l 201.97 Mfg 354.79	556.76
-805 Center Spar Assy	1.419	1.40	Mat'l 5.07 Mfg 21.64	26.71
-41 Spar Cap	10.2	.97	Mat'l 10.66 Mfg 32.28	42.94
-1 Assy		3.23	Mat'l 214.08 Tooling 248.04 Mfg 485.55	947.67
TOTAL		60.27	Mat'l 476.31 Tooling 248.04 Mfg 906.89	1631.24

BONDED TRIANGULAR CORE - ALUMINUM

610RA107

Dash No. No.	Raw Stock Weight	Finished Weight	Cost (In Dollars) Cost Breakdown		Total Cost
-3 Skin Panel Assy	15.64	14.63	Mat'l Mfg	20.07 13.87	33.94
-5 Skin Panel Assy	5.24	4.93	Mat'l Mfg	7.43 8.78	16.21
-53 Skin Panel Assy	5.48	5.30	Mat'l Mfg	7.80 8.78	16.58
-33 Front Spar	88.2	5.60	Mat'l Mfg	92.17 133.88	226.05
-35 Center Spar	85.7	3.79	Mat'l Mfg	239.10 132.76	371.86
-37 Rear Spar	100.8	5.91	Mat'l Mfg	105.34 153.80	259.14
-39 Web	.20	.14	Mat'l Mfg	.25 1.57	1.82
-41 Web	.21	.15	Mat'l Mfg	.27 1.57	1.84
-43 Tee	—	.45	Mat'l Mfg	1.26 1.06	2.32
-45 Tee	—	.51	Mat'l Mfg	1.42 1.06	2.48
-47 Angle	.04	.024	Mat'l Mfg	.05 1.57	1.62
-49 Angle	.05	.028	Mat'l Mfg	.06 1.57	1.63
-51 Tee		.884	Mat'l Mfg	2.46 4.80	7.26
-1 Assy		6.218	Mat'l Tooling Mfg	430.56 232.84 566.46	1229.86
TOTAL		48.72	Mat'l Tooling Mfg	908.24 232.84 1031.53	2172.61

ADHESIVE BONDED PANELS WITH CORRUGATED INNER SKIN
ALUMINUM

Dash No.	Raw Stock Weight	Finished Weight	Cost (In Dollars)		
			Cost Breakdown		Total Cost
-23 Skin	2.16	1.63	Mat'l Mfg.	22.90 19.52	42.42
-21 Skin	13.06	8.88	Mat'l Mfg	138.44 1.02	139.46
-25 Skin	2.23	1.64	Mat'l Mfg	23.64 19.52	43.16
-7 Stringer	5.96	5.27	Mat'l Mfg	63.18 7.33	70.51
-43 Stringer	7.00	1.23	Mat'l Mfg	46.90 92.51	139.41
-29 Skin	10.37	8.22	Mat'l Mfg	130.14 1.02	131.16
-31 Skin	2.31	1.88	Mat'l Mfg	22.52 19.52	42.04
-53 Stringer	3.64	.76	Mat'l Mfg	24.39 1.02	25.41
-7 Stringer	5.96	5.27	Mat'l Mfg	63.18 7.33	70.51
-55 Web	1.04	.92	Mat'l Mfg	21.79 1.02	22.81
-57 Stiffener	.35	.32	Mat'l Mfg	4.39 12.24	16.63
-37 Web	2.02	1.11	Mat'l Mfg	25.35 19.52	44.87
-39 Stiffener	.36	.31	Mat'l Mfg	3.82 12.24	16.06
-35 Cap	5.88	1.37	Mat'l Mfg	39.40 92.51	131.91

(Continued)

MULTIPLE TENSION STRAP/WELDED STIFFENER PRESSURE CARRYING STRUCTURE - TITANIUM

Dash No.	Raw Stock Weight	Finished Weight	Cost (In Dollars)	
			Cost Breakdown	Total Cost
-47 Web	2.24	1.14	Mat'l 25.35 Mfg 19.52	44.87
-49 Stiffener	.41	.34	Mat'l 4.35 Mfg 12.24	16.59
-45 Cap	5.21	1.16	Mat'l 34.91 Mfg 92.51	127.42
-9 Tension Strap	.25	.072	Mat'l 3.14 Mfg 25.66	28.80
-11 Tension Strap	.25	.077	Mat'l 3.14 Mfg 25.66	28.80
-13 Tension Strap	.25	.080	Mat'l 3.14 Mfg 25.66	28.80
-15 Tension Strap	.25	.080	Mat'l 3.14 Mfg 25.66	28.80
-17 Tension Strap	.25	.076	Mat'l 3.14 Mfg 25.66	28.80
-19 Tension Strap	.25	.070	Mat'l 3.14 Mfg 25.66	28.80
-1 Assy			Mat'l 654.62 Tooling 278.59 Mfg 427.73	1360.94
TOTAL		48.39	Mat'l 1370.87 Tooling 278.59 Mfg 1012.28	2661.74

MULTIPLE TENSION STRAP/WELDED STIFFENER
PRESSURE CARRYING STRUCTURE - TITANIUM

Dash No..	Raw Stock Weight	Finished Weight	Cost (In Dollars) Cost Breakdown		Total Cost
-7 Front Spar	87.50	2.86	Matl Mfg	91.44 192.51	283.95
-9 Rear Spar	87.50	2.84	Mat'l Mfg	91.44 192.56	284.00
-11 Skin	8.10	5.87	Mat'l Mfg	9.32 6.72	16.04
-15 Shim	.98	.64	Mat'l Mfg	1.13 11.18	12.31
-31 Stringer	16.20	.94	Mat'l Mfg	16.93 34.71	51.64
-33 Stringer	16.20	.94	Mat'l Mfg	16.93 34.71	51.64
-35 Stringer	16.20	..94	Mat'l Mfg	16.93 34.71	51.64
-37 Stringer	16.20	.94	Mat'l Mfg	16.93 34.71	51.64
-39 Stringer	16.20	.94	Mat'l Mfg	16.93 34.71	51.64
-41 Stringer	16.20	.94	Mat'l Mfg	16.93 34.71	51.64
-43 Center Spar Half	32.40	1.67	Mat'l Mfg	33.86 69.90	103.76
-13 Skin	8.10	5.87	Mat'l Mfg	9.32 6.72	16.04
-15	.49	.32	Mat'l Mfg	.80 5.59	6.39
-17	.49	.32	Mat'l Mfg	.80 5.59	6.39

(Continued)

DIAGONAL STEEL TENSION WIRE/ALUM PLATE - STRINGER CONSTRUCTION

610RA110 (Cont'd)

Dash No.	Raw Stock Weight	Finished Weight	Cost (In Dollars) Cost Breakdown		Total Cost
-19 Stringer	16.20	.94	Mat'l Mfg	16.93 34.71	51.64
-21 Stringer	16.20	.94	Mat'l Mfg	16.93 34.71	51.64
-23 Stringer	16.20	.94	Mat'l Mfg	16.93 34.71	51.64
-25 Stringer	16.20	.94	Mat'l Mfg	16.93 34.71	51.64
-27 Stringer	16.20	.94	Mat'l Mfg	16.93 34.71	51.64
-29 Stringer	16.20	.94	Mat'l	16.93	51.64
-45 Center Spar Half	32.40	1.67	Mat'l Mfg	33.86 69.90	103.76
-47 Wire	.44	.40	Mat'l Mfg	— —	—
-53 Collar		.02	Mat'l Mfg	24.00	24.00
Assy		5.58	Mat'l Tooling Mfg	38.67 207.72 324.45	570.84
TOTAL		39.34	Mat'l Tooling Mfg	537.80 207.72 1301.64	2047.16

DIAGONAL STEEL TENSION WIRE/ALUM PLATE - STRINGER CONSTRUCTION

SECTION III.5

MANUFACTURING TECHNOLOGY WORKSHEETS

TITLE	Multi-Wet Cell Construction (Large Full Depth Core)	DWG. NO.	610RA001
		CSS	140
			195.0#

MATERIAL	COMPONENT	ADV. MATL.
6-4 Ti	Upper Skin	Yes
8823 Ti	Lower Skins	Yes
8823 Ti	F.S. and R.S.	Yes
C.P. Ti	Core Cells	Yes
TX-21	Braze Alloy	Yes

MFG. PROCESS	COMPONENT	ADV. METH.
S. Weld and Braze	- Core Cells and Core to Spars	Yes
Weld	Butt Spar Web to Caps (E.B.)	Yes
Low Temp Braze	Lower Surface Skins, Core, and Spar Caps	Yes
Machine	Contour Mach. Ti Core	Yes

COMMENTS:

Look at Spot Welding as Alternate to Seam Welding in Core Fabrication

Look at GTA Welding of Spar Webs to Caps

Propose Hi Temp Braze Alloy for Upper Skin to Core Braze and Low Temp Braze Alloy for Lower Skin Braze. This will allow machining of Lower Contour After 1st Braze

Need Development of Low Temp Brazing

CONCEPT RATING

ADVANCED TECHNOLOGY			MANUFACTURING				COST FACTOR
MFG.	MATL.	TOTAL	BASIC	SECOND	FINAL	TOTAL	TOOL:
.0633	.0090	.0723	.0045	.0037	.0040	.0122	MFG:

TITLE	Brazed Sandwich Skins With Truss Member Core	DWG. NO.	610RA-002
		CSS	140.0
		Wt.	219.78

MATERIAL	COMPONENT	ADV. MATL.
6-4 Ti	Upper Skin and Truss Core F.S. and R.S. - Upper Aux Spar Caps Aux Spar Bonded Web Skins	Yes
8823 Ti	Lower Skin and Truss Core Lower Caps on Aux Spars	Yes

MFG. PROCESS	COMPONENT	ADV. METH.
Forming	Corrugated Core	Yes
Brazing	Skin-Core Panels	Yes

COMMENTS:

Look at -117, -119 and -121 details as a part of lower spar cap extrusion in lieu of formed details.

Need development of low temp brazing
Need development of corrugated core forming as an integral formed panel.
Make step in F & R spar webs opposite side to blade stiffener.

CONCEPT RATING

ADVANCED TECHNOLOGY			MANUFACTURING				COST FACTOR
MFG.	MATL.	TOTAL	BASIC	SECOND	FINAL	TOTAL	TOOL:
.0630	.0162	.0792	.0058	.0038	.0020	.0116	MFG:

TITLE	Laminated Lower Alum. Skin with Machined Stepped Spar Caps Al H/C Upper Skin	DWG. NO.	610RA003
		CSS	140.0 283.9

MATERIAL	COMPONENT	ADV. MATL.
7050 Alum.	All	Yes

MFG. PROCESS	COMPONENT	ADV. METH.
Adhesive Bond -	Lower Skin - Spar Laminates	Yes
Adhesive Bond -	Upper H/C Skin Panel	No
Machine	Spar and Spar Caps	No

COMMENTS:

Major area for developments is large laminated skins and spars of lower skin panel.

CONCEPT RATING

ADVANCED TECHNOLOGY			MANUFACTURING				COST FACTOR
MFG.	MATL.	TOTAL	BASIC	SECOND	FINAL	TOTAL	TOOL:
.0221	.0090	.0311	.0066	.0048	.0010	.0124	MFG:

TITLE	Al Honeycomb Sandwich Upper Panel - Titanium Blade Stiffened Plank Lower	DWG. NO.	610RA004 "A"
		CSS	140.0
		Wt.	240.0

MATERIAL	COMPONENT	ADV. MATL.
7050 Alum.	Upper Skin Panel	Yes
7050 Alum.	Spar Caps	Yes
8823 Ti	All Spar Components	Yes
8823 Ti	Lower Skin Panels	Yes

MFG. PROCESS	COMPONENT	ADV. METH.
Adhesive Bond	Upper Skin H/C Panel	No.
Weld "T" (Burn	Lower Skin and Spars	Yes
Braze (Low Temp)	Lower Skin Panels and Spar Caps	Yes

COMMENTS:

Major area of development required is in welding, hot sizing after welding and brazing.

Etched surface of spar webs should be away from blade stiffener
Unable to terminate blade stiffener T-Burn weld as shown on lower spar web. Show upper spar cap at R.S. same as at F.S.

CONCEPT RATING

ADVANCED TECHNOLOGY			MANUFACTURING				COST FACTOR
MFG.	MATL.	TOTAL	BASIC	SECOND	FINAL	TOTAL	TOOL:
.0351	.0162	.0513	.0069	.0025	.0030	.0124	MFG:

TITLE	Adhesive Bonded Laminated Lower Skin - Hat Stiffened Upper Skin	DWG. NO.	610RA 005
		CSS	140
		Wt.	300.88

MATERIAL	COMPONENT	ADV. MATL.
7050 Aluminum - All Components (Except H/C Core)		Yes

MFG. PROCESS	COMPONENT	ADV. METH.
Adhesive Bond	Lower Skin Laminate	Yes
Weldbond	Upper Skin to Hats	Yes
Adhesive Bond	H/C Panels - Spars	No
Adhesive Bond	Lower Skin and Spars	Yes

COMMENTS:

Adhesive Bonded Laminates of Skins and Full Depth Spars Require Development

Weldbonding process requires development for hat to skin attachment

CONCEPT RATING

ADVANCED TECHNOLOGY			MANUFACTURING				COST FACTOR
MFG.	MATL.	TOTAL	BASIC	SECOND	FINAL	TOTAL	TOOL:
.0216	.0090	.0306	.0084	.0018	.0030	.0132	MFG:

TITLE Laminated Lower Skin with Stepped Spar Caps

"Plate Upper Skin - Corr Spars

DWG. NO. 610RA006

CSS 140.0

Wt. 296.94

MATERIAL	COMPONENT	ADV. MATL.
7050 Alum	All	Yes

MFG. PROCESS	COMPONENT	ADV. METH.
Adhesive Bond	Lower Skin Laminate	Yes
Spot Weld	Web to Spar Caps	Yes

COMMENTS:

Development is needed in area of adhesive bonding laminated skin panel.

Suggest weldbonding be evaluated to replace spot welds.

CONCEPT RATING

ADVANCED TECHNOLOGY			MANUFACTURING				COST FACTOR
MFG.	MATL.	TOTAL	BASIC	SECOND	FINAL	TOTAL	TOOL:
.0113	.0090	.0203	.0075	.0055	.0030	.0160	MFG:

TITLE	Adhesive Bonded Laminate	DWG. NO.	610RA007
	Lower Skin - Bonded Hat Stiffeners	CSS	140.0
	Upper Skin	Wt.	246.17

MATERIAL	COMPONENT	ADV. MATL.
6-4 Ti	Upper Skin and Hats	Yes
6-4 Ti	Upper Spar Caps	Yes
8823 Ti	Spar Web and Stiffeners	
8823 Ti	Lower Skin Panels	
8823 Ti	Lower Skin Hat Stiffeners	Yes

MFG. PROCESS	COMPONENT	ADV. METH.
Form Etch	Lower Skin Panels	No
Form	Hat Section Skin Stiff.	No
Weld "T"Burn	Spar Web Stiffeners	Yes
Adhesive Bond	Lower Skin Laminate	Yes

COMMENTS:

Development is required to accomplish bonding of laminated lower skins and spar caps.

"T" Burn welding on lower skins will require development and testing.

Butt welds on spar webs need to be made after bonding lower panel

Suggest 8823 for upper hats to improve formability of shapes.

CONCEPT RATING

ADVANCED TECHNOLOGY			MANUFACTURING				COST FACTOR
MFG.	MATL.	TOTAL	BASIC	SECOND	FINAL	TOTAL	TOOL:
.0144	.0144	.0288	.0040	.0042	.0020	.0102	MFG:

TITLE	Brazed Space Truss Wing	DWG. NO.	610RA008
		CSS	140.0
		Wt.	200.94

MATERIAL	COMPONENT	ADV. MATL.
6-4 Ti	Upper Skin and Truss	Yes
6-4 Ti	Lower Truss Flange Angles	Yes
6-4 Ti	Front and Rear Spars	Yes
8823 Ti	Lower Doublers and Skins	Yes

MFG. PROCESS	COMPONENT	ADV. METH.
S. Weld and Braze -	Front and Rear Spars Hats - Flange Angles to Truss	Yes
Low Temp Braze	Lower Skin and Flange Angles and Spar Caps	Yes
Extrude	Frong and Rear Spar Caps	Yes

COMMENTS:

Need to develop a spot weld braze alloy combination for simplified brazing operations for 6-4 Ti.

Need low temp brazing alloy development for 8823 Ti.

CONCEPT RATING

ADVANCED TECHNOLOGY			MANUFACTURING				COST FACTOR
MFG.	MATL.	TOTAL	BASIC	SECOND	FINAL	TOTAL	TOOL:
.0540	.0117	.0657	.0074	.0034	.0020	.0128	MFG:

TITLE Modified Triangle Core, Adhesive Bonded, Aluminum

DWG. NO. 610RA009

CSS 140

Wt/ 300.00

MATERIAL	COMPONENT	ADV. MATL.
7050 Aluminum	All	Yes

MFG. PROCESS	COMPONENT	ADV. METH.
Extrude	Spar Details	Yes
Forming	Core Details	No
Adhesive Bond	Core Panel	Yes
Adhesive Bond	Lower Skin Laminate	Yes
Adhesive Bond	Spars to Skin Laminates	Yes

COMMENTS:

Break - 61 Skin in Multiple Sections for fabrication
Look at Weld Bonding and Rivet Bonding of -61 skin to truss nodes in lieu of adhesive bonding.
Adhesive Bonding of laminated skins will require development.
Bonding of full depth spars to skin laminates will require major development

CONCEPT RATING

ADVANCED TECHNOLOGY			MANUFACTURING				COST FACTOR
MFG.	MATL.	TOTAL	BASIC	SECOND	FINAL	TOTAL	TOOL:
.0139	.009	.0229	.0082	.0023	.0030	.0135	MFG:

TITLE Alum H/C Panel, Upper and Lower - Integral Lower Spar Caps - Adhesive Bonded

DWG. NO. 610RA010

CSS 140

Wt. 133.096

MATERIAL	COMPONENT	ADV. MATL.
7050 Aluminum	All	Yes

MFG. PROCESS	COMPONENT	ADV. METH.
Weld Bond	Spars - Web to Stiffeners	Yes
Adhesive Bond	Spars - Web Laminates	Yes
Adhesive Bond	Spar Caps and Lwr Skin	Yes

COMMENTS:

Developments are needed in weldbonding, laminated spar webs and bonding of full depth spars to lower skin

CONCEPT RATING

ADVANCED TECHNOLOGY			MANUFACTURING				COST FACTOR
MFG.	MATL.	TOTAL	BASIC	SECOND	FINAL	TOTAL	TOOL:
.0057	.0090	.0147	.0086	.0029	.0030	.0145	MFG:

TITLE	Bulbed - Tee Stiffened Skins (Upper and Lower)	DWG. NO.	610RA011
		CSS	140
		Wt.	239.70

MATERIAL	COMPONENT	ADV. MATL.
6-4 Ti	Upper Panel Assy	Yes
8823 Ti	Lower Panel Assy	Yes
8823 Ti	All Spar Assys	Yes

MFG. PROCESS	COMPONENT	ADV. METH.
Forming	Bulb-Tee Stiffeners	Yes
Welding	Spars - Web to Cap	No
Adhesive Bond	Skin - Stiffener Laminates	Yes
Adhesive Bond	Spar Sandwich Panels	No
Rivet	Clip to Blkhd and Stiffeners	No

COMMENTS:

Request use of 8823 Ti for upper bulb stiffeners for improved formability.

Unable to attach -71 intercostals as shown
Suggest removal of every other one or reverse position of every other one to provide some flexibility in stiffeners at assembly.

Look at Weldbonding or Rivetbonding of Intercostals to stiffeners on lower surface

Need fuel flow holes in stiffeners and spars

CONCEPT RATING

ADVANCED TECHNOLOGY			MANUFACTURING				COST FACTOR
MFG.	MATL.	TOTAL	BASIC	SECOND	FINAL	TOTAL	TOOL:
.0279	.0153	.0432	.0054	.0036	.0020	.0110	MFG:

TITLE	Adhesive Bonded Homeycomb Sandwich Skins and Spars	DWG. NO.	610RA012 "C"
		CSS	140
		Wt.	259.61

MATERIAL	COMPONENT	ADV. MATL.
6-4 Ti	Upper Skin Panels	Yes
8823 Ti	Lower Skin Panels	Yes
8823 Ti	Spar Panels	Yes
5056 Alum Core	All Panels	No

MFG. PROCESS	COMPONENT	ADV. METH.
Machining	F & R Spar Caps (Lower	No
Welding	Aux. Spar Caps (Lower)	Yes
Adhesive Bond	All Major	Yes
Forming	All Formed Details	Yes

COMMENTS:

Lower Spar Caps Front and Rear Spar Can not be machined to .025 Typ. dimension and contour.

Major fabrication problem is adhesive bonding of lower skin panel with full depth front and rear spars

Suggest rivetbonding of spar panels to spar caps.

CONCEPT RATING

ADVANCED TECHNOLOGY			MANUFACTURING				COST FACTOR
MFG.	MATL.	TOTAL	BASIC	SECOND	FINAL	TOTAL	TOOL:
.0063	.0153	.0216	.0033	.0051	.0010	.0124	MFG:

TITLE	Alum Honeycomb Sand~ Upper Panel - Titanium Blade Stiffened - Lower Panel	DWG. NO.	610RA013
		CSS	140
		Wt	254.17

MATERIAL	COMPONENT	ADV. MATL.
7050 Alum	Upper Skin Panel	Yes
6-4 Ti	All Spar Components	Yes
6-4 Ti	Lower Skin Panels	Yes

MFG. PROCESS	COMPONENT	ADV. METH.
Adhesive Bond	Upper Skin H/C Panel	No
Weld "T" Burn	Lower Skin and Spars	Yes
Weldbond	Lower Skin Panels and Spar Caps	Yes

COMMENTS:

Major area of development required is in T-burn welding, hot sizing after welding, and weldbonding.
Show upper spar cap at R.S. same as F.S.
Etched surface of spar webs should be away from blade stiffener.
Unable to terminate blade stiffener T-burn.
Weld as shown on lower spar web

CONCEPT RATING

ADVANCED TECHNOLOGY			MANUFACTURING				COST FACTOR
MFG.	MATL.	TOTAL	BASIC	SECOND	FINAL	TOTAL	TOOL:
.0234	.0090	.0324	.0069	.0029	.0030	.0128	MFG:

TITLE Adhesive Bonded Hat Stiffeners - Alum.

DWG. NO. 610RA101

CSS 340.000

MATERIAL	COMPONENT	ADV. MATL.
7050-T76 Alum	All	Yes

MFG. PROCESS	COMPONENT	ADV. METH.
Machine	F & R Spars	No
Form-Etch	Skins - Hats- Supports - Stiff - C.S.	No
Adh. Bond	Doublers & Hats to Skins	No
Adh. Bond	Ribs - Skins & Spars (Lower Surf.)	Yes
Weldbond	Upper Skin & Hat Assy	Yes
Rivet	Ribs in Place After Bonding	No

COMMENTS:

1. Major problem is in the area of holding details of the lower skin assembly during adhesive bonding cycle.
2. Development of weldbonding is needed.

CONCEPT RATING

ADVANCED TECHNOLOGY			MANUFACTURING				COST FACTOR
MFG.	MATL.	TOTAL	BASIC	SECOND	FINAL	TOTAL	TOOL:
.0135	.0090	.0225	.0080	.0036	.0030	.0146	MFG:

TITLE Sandwich Skin Panels, Integral Lower Spar Caps

DWG. NO. 610RA102

CSS 340.00

Wt. 39.84

MATERIAL	COMPONENT	ADV. MATL.
7050 Alum	All (Except Core)	Yes

MFG. PROCESS	COMPONENT	ADV. METH.
Machine	F & R Spars - Aux. Spar Webs	No
Extrude	Aux Spar Caps, Lower	No
Adh. Bond	Upper Skin H/C Panel	No
Adh. Bond	Lower H/C Skin Panel & Spars	Yes
Weldbond	Aux Spar Web to Lower Caps	Yes

COMMENTS:

1. Request extension of stiffener flanges on F & R Spars to remove angle cut and small cutter radius at lower spar cap.
2. Look at trade-off cost between plate and extrusion for lower aux. spar caps
3. Will need to develop method for bonding F & R spars with lower a/c panel.
4. Need to develop weldbonding for spars

CONCEPT RATING

ADVANCED TECHNOLOGY			MANUFACTURING				COST FACTOR
MFG.	MATL.	TOTAL	BASIC	SECOND	FINAL	TOTAL	TOOL:
.0060	.0090	.0150	.0076	.0048	.0024	.0148	MFG:

TITLE	Adhesive Bonded	DWG. NO.	610RA103
	Close Spar Spacing	CSS	340.000
		Wt.	24.807

MATERIAL	COMPONENT	ADV. MATL.
7050-T76	All (Except GRP)	Yes

MFG. PROCESS	COMPONENT	ADV. METH.
Machine	F & R Spar	No
Form	All Sheet Metal Details	No
Adh. Bond	All Details	Yes

COMMENTS:

1. Major problem is to develop a bonding method. A proposed method is to bond multiples of 3 cells employing a hard center cell mandrel during bonding. Bond all cells together with skins and splice plates as a second operation.

CONCEPT RATING

ADVANCED TECHNOLOGY			MANUFACTURING				COST FACTOR
MFG.	MATL.	TOTAL	BASIC	SECOND	FINAL	TOTAL	TOOL:
.0225	.0090	.0315	.0103	.0024	.0040	.0167	MFG:

TITLE Integral Formed Bulbed Tee - Alum

DWG. NO. 610BA104

CSS 340.000

Wt. 40.75

MATERIAL	COMPONENT	ADV. MATL.
7050-T76 Alum	All	Yes

MFG. PROCESS	COMPONENT	ADV. METH.
Machine	All Spars	No
Machine & Etch	Ribs	No
Form	Skins	No
Integral Form	Skin Stiffened Panel	Yes
Adh. Bond	Laminated Skin Stiff Panel	Yes
Adh. Bond	Spar - Laminated Skin Panel	Yes
Weldbonding	Clips to U.Skin and Inner Skin	Yes

COMMENTS:

1. Integral forming of stiffened panels need development
2. Adh. bonding of laminated panel needs development.
3. Adh. bonding of full depth spars and integral stiffened laminated skin panel needs development.
4. Application of adhesive to inner surface of bulb stiffener is a major problem area for fabrication.

CONCEPT RATING

ADVANCED TECHNOLOGY			MANUFACTURING				COST FACTOR
MFG.	MATL.	TOTAL	BASIC	SECOND	FINAL	TOTAL	TOOL:
.0234	.0090	.0324	.0041	.0048	.0030	.0119	MFG:

TITLE	Multi-Wet Cell Construction	DWG. NO.	610RA-105
		CSS	340.000
		Wt.	33.97

MATERIAL	COMPONENT	ADV. MATL.
6 Al 4V Titanium	U & L Skins and Spars	Yes
C.P. Titanium	Core Cells	Yes
TX-21	Braze Alloy	Yes

MFG. PROCESS	COMPONENT	ADV. METH.
Extrude & Form	Spar Caps	Yes
Weld	Spar Caps to Webs	Yes
Form and Weld	Core Cells	Yes
Spot Weld & Braze	Core to U. Skin & Spars	Yes
Machine	Core to contour	Yes
Low Temp Braze	Core to Lower Skin	Yes
Low Temp Braze	Lower Spar Cap to Lower Skin	Yes

COMMENTS: The following areas of fabrication need development

1. Fabricating large core cells of titanium
2. Machining titanium core to contour.
3. Extruding and forming titanium spar caps
4. Brazing of titanium core wing box panel
5. Development of large scale brazing tools.

CONCEPT RATING

ADVANCED TECHNOLOGY			MANUFACTURING				COST FACTOR
MFG.	MATL.	TOTAL	BASIC	SECOND	FINAL	TOTAL	TOOL:
.0546	.0045	.0621	.0045	.0036	.0040	.0121	MFG:

TITLE Bonded Triangular Core - Aluminum

DWG. NO. 610RA106

CSS 340.000

Wt. 60.27

MATERIAL	COMPONENT	ADV. MATL.
7050-T76 Alum	All Except Glass and H/C Core	Yes

MFG. PROCESS	COMPONENT	ADV. METH.
Machine	Spar Caps	No
Form	Truss Core and Skins	No
Adh. Bond	Skin and Spar Panels	No
Adh. Bond	Assy of F & R Spars and Lower Skin Panel	Yes

COMMENTS:

Major fabrication problem is in bonding of front and rear spars to lower truss core skin panel.

There is no process for forming truss core as shown on this drawing. It is proposed that formed or extruded sections as shown on Sheet 2 be used in lieu of corrugations shown.

CONCEPT RATING

ADVANCED TECHNOLOGY			MANUFACTURING				COST FACTOR
MFG.	MATL.	TOTAL	BASIC	SECOND	FINAL	TOTAL	TOOL:
.0032	.0090	.0120	.0080	.0048	.0030	.0158	MFG:

TITLE **Bonded Triangular Core - Aluminum**

DWG. NO. **610RA106**

CSS **340,000**

MATERIAL

COMPONENT

ADV. MATL.

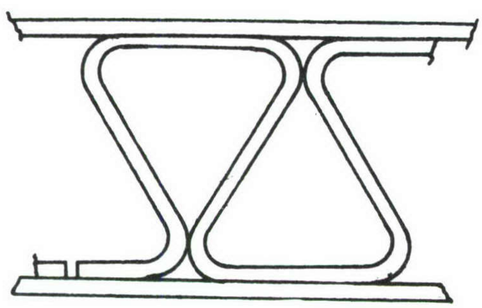
MFG. PROCESS

COMPONENT

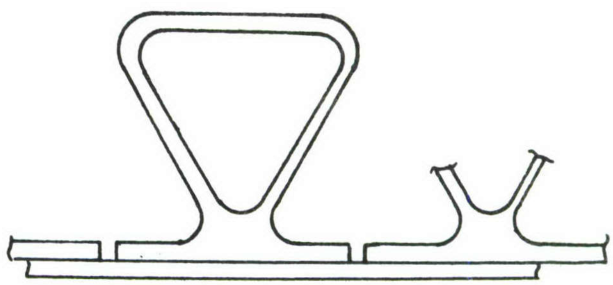
ADV. METH.

These sections are proposed alternates to the truss core design shown on existing design.

Formed Section



Extruded Section



CONCEPT RATING

ADVANCED TECHNOLOGY			MANUFACTURING				COST FACTOR
MFG.	MATL.	TOTAL	BASIC	SECOND	FINAL	TOTAL	TOOL: MFG:

TITLE	Adhesive Bonded Panels with Corrugated Inner skin	DWG. NO.	610RA107
		CSS	340.000
		Wt.	50.57

MATERIAL	COMPONENT	ADV. MATL.
7050 Alum		Yes

MFG. PROCESS	COMPONENT	ADV. METH.
Extrusion	C.S. & All "T" Sections	No
Machine	F & R Spars	No
Form	Skins (Inner and Outer)	No
Adh. Bond	U & L Skin Panels	No
Adh. Bond	C.S. Web Stiffeners	No
Adh. Bond	Radius Blocks	No
Adh. Bond	Spars to Lower Skin Panel	Yes

COMMENTS:

Major fabrication problem is in bonding spars to lower skin panels.

CONCEPT RATING

ADVANCED TECHNOLOGY			MANUFACTURING				COST FACTOR
MFG.	MATL.	TOTAL	BASIC	SECOND	FINAL	TOTAL	TOOL:
.0032	.0090	.0122	.0077	.0036	.0030	.0143	MFG:

TITLE	Rectangular Tube Stiffened Panels Integral Spar Cap	DWG. NO.	610RA108
		CSS	340,000
		Wt.	41.588

MATERIAL	COMPONENT	ADV. MATL.
6Al-4V Titanium	All	Yes

MFG. PROCESS	COMPONENT	ADV. METH.
Machine	Spars & Spar Caps	No
Form	Front and Rear Spars	No
Weld "T" Burn	Spar Web and Stiffeners	Yes
Weld "T" Burn	Upper and Lower Panels	Yes
Weld "T" Burn	Ribs to Upper and Lower Panels	Yes

COMMENTS:

1. Unable to weld spar stiffeners as shown
2. Unable to weld aux spars and ribs as shown
3. Can not produce and inspect skin panels
4. Not economically feasible to manufacture

CONCEPT RATING

ADVANCED TECHNOLOGY			MANUFACTURING				COST FACTOR
MFG.	MATL.	TOTAL 0	BASIC	SECOND	FINAL	TOTAL 0	TOOL:
See Comment No. 4			See Comment No. 4				MFG:

TITLE Multiple Tension Strap/Welded Stiffener - Pressure Carrying Structure

DWG. NO. 610RA109

CSS 340.000

Wt. 48.39

MATERIAL	COMPONENT	ADV. MATL.
6Al 4V Titanium	All	Yes

MFG. PROCESS	COMPONENT	ADV. METH.
Machine	Spar Caps	No
Etch	Skin and Tension Tie Details	No
Form-Size	Skins and Stiffener Angles	No
T-Weld	Skins and Stiffener Angles	Yes
T-Weld	(3) Spar Webs Stiffeners	Yes
Butt Weld	Spar Webs to Caps	No

COMMENTS:

Need development in the process of welding stiffeners to skins and subsequently performing a stress relieving and sizing operation

CONCEPT RATING

ADVANCED TECHNOLOGY			MANUFACTURING				COST FACTOR
MFG.	MATL.	TOTAL	BASIC	SECOND	FINAL	TOTAL	TOOL:
.0324	.0090	.0414	.0064	.0042	.0016	.0122	MFG:

TITLE Diagonal Steel Tension Wire/Alum Plate Stringer Construction

DWG. NO. 610RA110

CSS 340.000

Wt. 39.34

MATERIAL	COMPONENT	ADV. MATL.
7050 Alum	Skins - Spars - Stringers	Yes

MFG. PROCESS	COMPONENT	ADV. METH.
Machine	Spars and Stringers	No
Form	Skins	No
Adh. Bond	Skin - Stringers and C. Spar	No
Wire Stringing	Upper and Lower Panels	No

COMMENTS:

Major fabrication problem is developing a technique for stringing wire between upper and lower panels and obtaining the desired tension in a uniform pattern.

CONCEPT RATING

ADVANCED TECHNOLOGY			MANUFACTURING				COST FACTOR
MFG.	MATL.	TOTAL	BASIC	SECOND	FINAL	TOTAL	TOOL:
0000	.0090	.0090	.0058	.0030	.0015	.0103	MFG:

SECTION III.6

INSPECTABILITY WORKSHEETS

INSPECTABILITY RATING

DRAWING NO. 610RA000

BASELINE: 100%

PART NAME AND DASH NUMBER	OVERALL AVG. (%)		MIN. NDI DETECT. CRACK LTH/METHOD	SCORE (.05)
	RATE	MAX.		
Upper Skin		30	.150/Pen,X-ray UT	.015
Lower Skin		40		.020
Internal		30		.015
TOTAL		100		.050

COMMENTS:

INSPECTABILITY RATING

DRAWING NO. 610RA001

BASELINE: 100%

PART NAME AND DASH NUMBER	OVERALL AVG. (%) RATE	MAX.	MIN. NDI DETECT. CRACK LTH/METHOD	SCORE (.05)
1. -7 Upper Skin Assy	20	30	-150/UT, PEN	.01
2. -9 Lower Skin Assy	25	40	-150/UT, PEN	.0125
3. Internal (Total)	(14)	(30)		
-11	2.8	3	-15/UT, PEN X-Ray	.0014
-13	2.8	3		.0014
-15	2.8	3		.0014
-17	2.8	3		.0014
-19	1.3	1.5		.00065
-21	1.3	1.5		.00065
-23	1.0	1.5		.005
-25		n/a		
-27		n/a		
TOTAL	69			.0344

COMMENTS:

INSPECTABILITY RATING

DRAWING NO. 610RA002

BASELINE: 100%

PART NAME AND DASH NUMBER	OVERALL AVG. (%) RATE	MAX.	MIN. NDI DETECT. CRACK LTH/METHOD	SCORE (.05)
1. -7 Upper Panel	16	30	.100/UT, X-Ray	.008
2. -19 Lower Panel	22	40	.100/UT, X-ray	.011
3. Internal		(30)	.150/PEN, UT	
-9 FS	4.1	6		.00205
-11 FAS	5.1	6	X-ray	.00255
-13 CS	5.1	6		
-15 AAS	5.1	6		
-17 AS	4.1	6		.00205
TOTAL	61.5			.0375

COMMENTS:

INSPECTABILITY RATING

DRAWING NO. 610RA003

BASELINE: 100%

PART NAME AND DASH NUMBER	OVERALL AVG. (%)		MIN. NDI DETECT. CRACK LTH/METHOD	SCORE (.05)
	RATE	MAX.		
1. -3 Spar-Skin	58	70	.120/Pen, UT	.029
2. -5 Skin Panel	20	30	.15/Pen, UT-Xray	.01
TOTALS	78			.039

COMMENTS:

1. All easily inspected except multilayer bond.
2. Complete stripping required for penetrant inspection.

INSPECTABILITY RATING

DRAWING NO. 610RA004A

BASELINE: 100%

PART NAME AND DASH NUMBER	OVERALL AVG. (%)		MIN. NDI DETECT. CRACK LTH/METHOD	SCORE (.05)
	RATE	MAX.		
1. -3 Skin Panel	27	30	.100/Pen, UT	.0135
2. -15/-21 Skin Assy	27	40	.150/UT	.0135
3. -63/-65 Spar Caps	10	10	.05/Pen	.005
4. -5/-13 Beam Assy	10	20	.100/Pen, UT	.005
TOTALS	74			.037

COMMENTS:

1. Burn thru "T"s very costly to inspect.
2. Complete stripping required for penetrant inspection.

INSPECTABILITY RATING

TABLE X

DRAWING NO. 610RA005

BASELINE: 100%

PART NAME AND DASH NUMBER	OVERALL AVG. (%) RATE	MAX.	MIN. NDI DETECT. CRACK LTH/METHOD	SCORE (.05)
1. -3 Upper Skin	24	30	.09 UT, PEN	.015
2. -5 Lower Skin	22	40	.15 UT, X-RAY	.011
3. Internal		(30)	.15 UT, X-RAY	
-87 FS	3.2	6		.0016
-89 FAS	3.2	6		.0016
-91 CS	3.2	6		.0016
-93 AAS	3.2	6		.0016
-95 RS	3.2	6		.0016
TOTALS	62	100		.031

COMMENTS:

1. Formed hats cannot be 100% inspected at depot level without complete disassembly and stripping.
2. Steps in spars can increase inspection costs.

INSPECTABILITY RATING

DRAWING NO. 610RA006

BASELINE: 100%

PART NAME AND DASH NUMBER	OVERALL AVG. (%)		MIN. NDI DETECT. CRACK LTH/METHOD	SCORE (.05)
	RATE	MAX.		
1. -65 Upper Skin	30	30	.05/Pen	.015
2. -3 Spar Skin Assy	45	70	.150/UT, X-ray	.0225
TOTALS	75	100		.0375

COMMENTS:

1. Can only detect gross damage in corrogations after assembly.

2. -3 minimum crack length determined by the difficulty of detecting cracks in inter-laminia of lower skin.

INSPECTABILITY RATING

DRAWING NO. 610RA007

BASELINE: 100%

PART NAME AND DASH NUMBER	OVERALL AVG. (%)		MIN. NDI DETECT. CRACK LTH/METHOD	SCORE (.05)
	RATE	MAX.		
1. -7 Upper Panel	26	30	.100/Pen, UT, X-ray	.013
2. -19 Lower Panel	30	40	.100/Pen , UT, X-ray	.015
3. Internal		(30)	.150/Pen,UT, X-ray	
-9FS	3.5	5		.00175
-11FAS	3.5	5		.00175
-13 CS	3.5	5		.00175
-15 AAS	3.5	5		.00175
-17 AS	3.5	5		.00175
-165 thru -187 Ribs	4.5	5		.00225
TOTAL	78	100		.039

COMMENTS:

INSPECTABILITY RATING

DRAWING NO. 610RA008

BASELINE: 100%

PART NAME AND DASH NUMBER	OVERALL AVG. (%)		MIN. NDI DETECT. CRACK LTH/METHOD	SCORE (.05)
	RATE	MAX.		
1. Upper Skin -7	23	30	.15/UT	.0115
2. -9 Lower Skin	30	40	.15/UT	.015
3. Internal				
-11 FS	6	10	.12/UT, Pen	.003
-13 RS	6	10	.12/UT, Pen	.003
-15/-27 Truss Assy	6	10	.12/UT, Pen	.003
TOTALS	71	100		.0355

COMMENTS:

1. Disassembly of trusses will be required for field inspection.
2. Complete stripping required for penetrant inspection.
3. 100% depot level inspect. very costly.

INSPECTABILITY RATING

DRAWING NO. 610RA009

BASELINE: 100%

PART NAME AND DASH NUMBER	OVERALL AVG. (%)		MIN. NDI DETECT. CRACK LTH/METHOD	SCORE (.05)
	RATE	MAX.		
1. -3 Spar Skin Assy	50	70	.120/UT	.025
2. -5 Skin Panel	22	30	.100/UT	.011
TOTALS	72	100		.036

COMMENTS:

1. Cannot inspect for cracks in hat sections after bonding.

INSPECTABILITY RATING

DRAWING NO. 610RA010

BASELINE: 100%

PART NAME AND DASH NUMBER	OVERALL AVG. (%)		MIN. NDI DETECT. CRACK LTH/METHOD	SCORE (.05)
	RATE	MAX.		
1. -7 Upper Panel	26	30	.100/PEN, UT	.013
2. -19 Lower Panel	36	40	.100/Pen, UT	.018
3. Internal			.150/PEN, UT X-ray	
-9 FS	3.5	6		.00175
-11 FAS	3.5	6		.00175
-13 CS	3.5	6		.00175
-15 AAS	3.5	6		.00175
-17 AS	3.5	6		.00175
TOTAL	79.5	100		.03975

COMMENTS:

INSPECTABILITY RATING

DRAWING NO. 610RA011

BASELINE: 100%

PART NAME AND DASH NUMBER	OVERALL AVG. (%) RATE	MAX.	MIN. NDI DETECT. CRACK LTH/METHOD	SCORE (.05)
1. -7 Upper Panel	18	30	.150/UT	.009
2. -9 Lower Panel	21	40	.150/UT	.0105
3. Internal		(30)	.100/Pen, UT	
-11 FS	4.2			.0021
-13 FS	4.2			.0021
-15 CS	4.2			.0021
-17 AAS	4.2			.0021
-19 RS	4.2			.0021
-127 Bhd. Assy -129 " -131 " -133 "	4.5			.0023
TOTALS	64.5	100		.03225

COMMENTS:

1. Bulbed "T's very difficult and costly to inspect.
2. Complete stripping required for penetrant inspection in the field.

INSPECTABILITY RATING

DRAWING NO. 610RA012A

BASELINE: 100%

PART NAME AND DASH NUMBER	OVERALL AVG. (%) RATE	MAX.	MIN. NDI DETECT. CRACK LTH/METHOD	SCORE (.05)
1. Upper Skin -807	25	30	.100/UT, Pen	.0125
2. Lower Skin - 805	33	40	.100/UT, Pen	.0165
3. Internal		(30)	.100/UT, Pen	
-1 FAS	5	6		.0025
-3 CS	5	6		.0025
-5 AAS	5	6		.0025
-801 FS	4.8	6		.0024
-803 RS	4.8	6		.0024
TOTALS	82.6	100		.0413

COMMENTS:

1. Can detect only gross damage to core after assembly.
2. Complete stripping required for penetrant inspections.

INSPECTABILITY RATING

DRAWING NO. 610RA013

BASELINE: 100%

PART NAME AND DASH NUMBER	OVERALL AVG. (%)		MIN. NDI DETECT. CRACK LTH/METHOD	SCORE (.05)
	RATE	MAX.		
1. -3 Skin Panel	22	30	.15 UT PEN X-ray	.011
2. -15/-21 Skin Assy	25	40	.15 UT PEN X-ray	.0125
3. -5/-13 Beam Assy	26	30	.090 PEN	.013
TOTAL	73	100		.0365

COMMENTS:

INSPECTABILITY RATING

DRAWING NO. 610RA100

BASELINE: 100%

PART NAME AND DASH NUMBER	OVERALL AVG. (%)		MIN. NDI DETECT. CRACK LTH/METHOD	SCORE (.05)
	RATE	MAX.		
Upper Skin		30	.150/PEN, X-Ray, UT	.015
Lower Skin		40		.020
Internal		30		.015
TOTAL		100		.050

COMMENTS:

INSPECTABILITY RATING

DRAWING NO. 610RA101

BASELINE: 100%

PART NAME AND DASH NUMBER	OVERALL AVG. (%)		MIN. NDI DETECT. CRACK LTH/METHOD	SCORE (.05)
	RATE	MAX.		
1. -5 Skin Panel	30	40	.100/Pen	.015
2. -3 Spar - Skin	35	60	.15/UT	.0175
TOTALS	65	100		.0325

COMMENTS:

1. Very difficult to inspect radii in bonded "T".

2. Complete stripping required for penetrant inspections.

INSPECTABILITY RATING

DRAWING NO. 610RA102

BASELINE: 100%

PART NAME AND DASH NUMBER	OVERALL AVG. (%)		MIN. NDI DETECT. CRACK LTH/METHOD	SCORE (.05)
	RATE	MAX.		
1. -7 Upper Panel	27	30	.150/PEN, UT	.0135
2. -17 Lower Panel	37	40	.150/PEN, UT	.0185
3. Internal		30	.100/PEN, UT. X-Ray	
-9 FS	7	7.25		.0035
-11 FAS	6.5	7.25		.00325
-13 AAS	6.5	7.25		.00325
-15 AS	7	7.25		.0035
TOTAL	91	100		.0455

COMMENTS:

INSPECTABILITY RATING

DRAWING NO. 610RA103

BASELINE: 100%

PART NAME AND DASH NUMBER	OVERALL AVG. (%)		MIN. NDI DETECT. CRACK LTH/METHOD	SCORE (.05)
	RATE	MAX.		
1. Upper Skin Assy.	24	30	.15/UT	.012
2. Lower Skin Assy.	34	40	.15/UT	.017
3. *Spars (All)	0	30	0/X	0
TOTALS	58	100		.029

COMMENTS:

1. Spars are not inspectable after assembly. Must be designed such that no inspection is required.

   *Spar Rating will be 0 or 30% according to the damage tolerance features.

INSPECTABILITY RATING

DRAWING NO. 610RA104

BASELINE: 100%

PART NAME AND DASH NUMBER	OVERALL AVG. (%)		MIN. NDI DETECT. CRACK LTH/METHOD	SCORE (.05)
	RATE	MAX.		
1. -3 Skin Panel Assy	15	30	.15 UT X-ray	.0075
2. -5 Spar Skin Assy	26	70	.15 UT X-Ray	.013
TOTAL	41	100		.0205

COMMENTS:

1. Bulb Tees and weld bonds are very costly to inspect.
2. NDI development costs would be high for 100% inspection.
3. Complete stripping required for penetrant inspection.

INSPECTABILITY RATING

DRAWING NO. 610RA105

BASELINE: 100%

PART NAME AND DASH NUMBER	OVERALL AVG. (%)		MIN. NDI DETECT. CRACK LTH/METHOD	SCORE (.05)
	RATE	MAX.		
1. -7 Upper Skin	21	30	.09 PEN	.0105
2. -9 Lower Skin	28	40	.09 PEN	.014
3. Internal				
-11 FS	7	10	.100 PEN UT	.0035
-19 RS	7	10		.0035
-27 Web Assy	6	10		.003
TOTALS	69			.0345

COMMENTS:

1. Full depth core must be designed for full service life. Only gross damage can be detected after assembly.

INSPECTABILITY RATING

DRAWING NO. 610RA-106

BASELINE: 100%

PART NAME AND DASH NUMBER	OVERALL AVG. (%)		MIN. NDI DETECT. CRACK LTH/METHOD	SCORE (.05)
	RATE	MAX.		
1. -3 Skin Panel Assy	17	30	.120/UT, Pen.	.0085
2. -5 Spar Skin Assy	33	60	.120/UT, Pen.	.0165
3. -805 CS	9	10	.07/Pen.	.0045
	59	100		.0295

COMMENTS:

INSPECTABILITY RATING

DRAWING NO. 610RA107

BASELINE: 100%

PART NAME AND DASH NUMBER	OVERALL AVG. (%)		MIN. NDI DETECT. CRACK LTH/METHOD	SCORE (.05)
	RATE	MAX.		
1. -3, -5, -53 Skin Assys	40	70	.150/Pen, UT, X-ray	.02
2. -33, -35, -37 Spars	15	20	.100/Pen, UT	.0075
3. -39, -41 Webs	10	10	.07/Pen	.005
TOTALS	65	100		.0325

COMMENTS:

1. Internal corrogations of front and rear spars cannot be inspected after forming.
2. Very costly to inspect formed hats at depot level.
3. Complete stripping required for penetrant inspections.

INSPECTABILITY RATING

DRAWING NO. 610RA108

BASELINE: 100%

PART NAME AND DASH NUMBER	OVERALL AVG. (%)		MIN. NDI DETECT. CRACK LTH/METHOD	SCORE (.05)
	RATE	MAX.		
1. -5 Upper Skin	22	30	.05/Pen	.011
2. -3 Lower Skin	29	40	.05/Pen	.0145
3. Internal	25	30	.09/UT, Pen	.0125
TOTALS	76	100		.0380

COMMENTS:

1. Multiple welds costly to inspect
2. Internal skin stiffeners can only be inspected for gross damage at depot level.
3. Complete stripping required for penetrant inspection.

INSPECTABILITY RATING

DRAWING NO. 610RA109

BASELINE: 100%

PART NAME AND DASH NUMBER	OVERALL AVG. (%) RATE	OVERALL AVG. (%) MAX.	MIN. NDI DETECT. CRACK LTH/METHOD	SCORE (.05)
1. Upper Skin Assy -27	22	30	.07/Pen, X-ray	.011
2. Lower Skin Assy -33	25	40	.07/Pen, X-ray	.0125
3. Internal		(30)		
-59 Web Assy	10	10	.04/Pen	.005
-41 FS Assy	8	10	.05/Pen	.004
-51 RS Assy	8	10	.05/Pen, X-ray	.004
TOTALS	73	100		.0365

COMMENTS:

1. Very high disassembly costs will be associated with this design. Suggest web assemblies be designed for full service life.

INSPECTABILITY RATING

DRAWING NO. 610RA110

BASELINE: 100%

PART NAME AND DASH NUMBER	OVERALL AVG. (%)		MIN. NDI DETECT. CRACK LTH/METHOD	SCORE (.05)
	RATE	MAX.		
1. -55 Upper Skin Assy	23	30	.15 UT PEN	.0115
2. -57 Lower Skin Assy	31	40	.15 UT PEN	.0155
3. Internal		(30)	.15 UT PEN	
-7 FS	10	10		.005
-9 RS	10	10		.005
-47 Wire Assy	9	10		.0045
TOTAL	83	100		.0415

COMMENTS:

1. Wire assy must be designed for full service life. Only gross damage can be detected in field inspections.
2. Penetrant inspections require complete stripping.

APPENDIX IV

PRELIMINARY DESIGN DRAWINGS

IV.1 SUMMARY

During the fourth step of this program, nine preliminary design drawings were completed. These designs were based on top ranking analytical assembly concepts evaluated in the previous step of the program. The analytical assembly concepts are described in Appendix III; ANALYTICAL ASSEMBLY DRAWINGS.

Evaluation of the nine designs was based on the numerical merit rating system as developed in the earlier portions of this program. Four of the highest ranking designs were chosen for further iteration in the Optimization Phase to complete Phase IA of this total effort.

IV.2 PRELIMINARY CONFIGURATION SELECTION

This section discusses the selection of nine configurations for the preliminary design phase of the program. It traces the concepts from the initial Element Concept phase, through the Cross-Section Drawing and the Analytical Assembly phases, to their eventual inclusion in a Preliminary Design Concept.

IV.2.1 Analytical Assembly Matrix

Selecting configurations for preliminary design was greatly simplified through the use of data generated as part of the Analytical Assembly phase of the program (reference Appendix III. Using the information available from the twenty-five (25) A/A drawings, a large number of full wing configurations could be considered. This matrix of concepts was used to predict cost, weight, technology advancement, structural integrity, and abilities of many wing configurations. From this matrix, nine wing configurations were chosen for further iterations.

The techniques for accomplishing this are described in the following paragraphs.

IV.2.1.1 Summary of A/A Work

A total of twenty-five (25) Analytical Assembly drawings were made, including baseline drawings at CSS 140 and 340, during the third step of this program. The Analytical Assemblies

evolved from the 119 Element Concepts and 53 Cross-Section drawings generated during earlier steps in this program. Each Analytical Assembly was a 48 inch span of constant cross-section, and allowed a more detailed weight, cost and strength analysis than could be performed during earlier steps. The complete evaluation and ranking of the Analytical Assemblies is reported in Appendix III, Phase Summary-Analytical Assemblies, dated April 11, 1973. Table XXVIII shows the evolution of Element Concepts to Preliminary Designs.

IV.2.1.2 Technique for Projecting Analytical Assembly Data to Full Wing Boxes

Methods of arriving at full wing box weights and costs from Analytical Assemblies was devised. These methods were checked on the baseline wing box and were shown to give an accurate estimate of weight and cost. These methods are described in the pargraphs that follow.

IV.2.1.2.1 Weight Estimation Technique

Baseline "Analytical Assemblies" (AA's) of constant cross-section, and forty eight inches in span were carefully sized to provide accurate weight calculations along the span at baseline center spar stations (C.S.S.) 140 and 340. Sizing of these AA's reflected the required lower surface stress level changes due to preliminary design fracture allowables for C.S.S. 140. Fracture allowables for C.S.S. 340 have no impact due to the smaller wing loads at this outboard station.

The basic structural weights for a wing were calculated using weight data directly from the AA's in accordance with the following formula:

$$W_{\text{full wing}} = \frac{W_{CSS140} + W_{CSS340}}{2} \times \text{Length (Splice to Tip)} + W_{\text{recurring}}$$

Where W_{CSS140} is the weight of the A/A at C.S.S. 140 ÷ 48"

W_{CSS340} is the weight of the A/A at C.S.S. 340 ÷ 48",

Length is 278 inches

W recurring is the weight of recurring items such as pylons, etc. (355 pounds in this study - reference Table XXIX).

Table XXVIII
DESIGN TRACEABILITY - PRELIMINARY DESIGN CONFIGURATIONS

DWG. NO.	ELEMENT CONCEPT FZM-6057	CROSS-SECTION FZM-6058	ANALYTICAL ASSEMBLY FZM-6086	REMARKS
610RW 001	610-132	610R-013B 610R-028 610R-029 610R-117	610RA-003	Payoffs and Development Required identified in Monthly Status Report dated 14 January 1973
610RW 002	610-133	610R-007 610R-014 610R-101B 610R-108	610RA-001	Payoffs and Development Required identified in Monthly Status Report dated 14 January 1973.
610RW 003	610-132 610-217 610R-013B 610R-029	610R-013B 610R-029	610RA-006	Payoffs and Development Required identified in Monthly Status Report dated 14 January 1973
610RW 004	610-128	610R-005 610R-011 610R-028 610R-117	610RA-010 610RA-102	
610RW 005	610-003 610-128	610R-001 610R-027 610R-107	610RA-012C	
610RA 006	610-216 610-217 610-305	610R-0156	610RA-008	Payoffs and Development Required identified in Monthly Status Report dated 14 January 1973
610RW 007	610-124 610-132 610-013B 610R-629	610R-001 610R-002 610R-025 610R-029 610R-119	610RA-005 610RA-101	Payoffs and Development Required Identified in Monthly Status Report dated 14 January 1973

(Continued)

Table XXVIII

DESIGN TRACEABILITY - PRELIMINARY DESIGN CONFIGURATIONS (Continued)

DWG NO.	ELEMENT CONCEPT FZM-6057	CROSS-SECTION FZM-6058	ANALYTICAL ASSEMBLY FZM-6086	REMARKS
610RW 008	610-124 610-132 610-0138 610R-029	610R-001 610R-002 610R-013B 610R-025 610R-029 610R-119 610R-102	610RA-005 610RA-103	Two design configurations spliced together.
610RW 009	610-132 610-217 610R-013B 610R-029	610R-013B 610R-029 610R-102B	610RA-006 610RA-103	Two design configurations spliced together

Using this technique it was possible to estimate the weight of any combination of Analytical Assemblies from the A/A matrix.

IV.2.1.2.2 Development of Weight Estimation Technique

The technique discussed above was developed and verified using the baseline F-111F and the Analytical Assemblies 610RA000 and 610RA100.

Weights of the F-111F baseline wing were calculated for unit cross-sections at various points along the span, using these "Analytical Assemblies" (AA's).

These data were used to show distribution of basic structural weight along the baseline span in Figure 4. The baseline weight distribution is shown for the case of 47.8 ksi and 39.0 ksi maximum, ultimate, lower surface tension stress at CSS 140. The AA's at CSS 140 differed by 40.5 lbs (.84 lbs/in) due to this design stress change.

The basic structural weights for one side of the wing have also been calculated in Table XXIX using weight data directly from AA's. This procedure calculates 1197 lbs., versus 1193 lbs for σ = 47.8 ksi in Figure 4; and 1315 lbs versus 1303 lbs for σ = 39.0 ksi in Figure 4.

This procedure also enables the calculations of weight variations with respect to lower surface design stress as shown in Table XXX. These calculated weights and stresses are plotted in Figure 5.

It has been assumed that recurring weights, such as pylon provisions, etc., described in Table XXIX will be constant. This enables a consistent appraisal of the variations of weight of the more critical members.

The accuracy of this procedure generally compares well to the more tedius method of calculating weights for unit cross-sections at various points along the span, plotting the data, and integrating the curve to obtain total wing weights.

IV.2.1.2.3 Cost Estimation Technique

Costs used in projecting the A/A matrix were estimated using a technique similar to the weight estimation technique

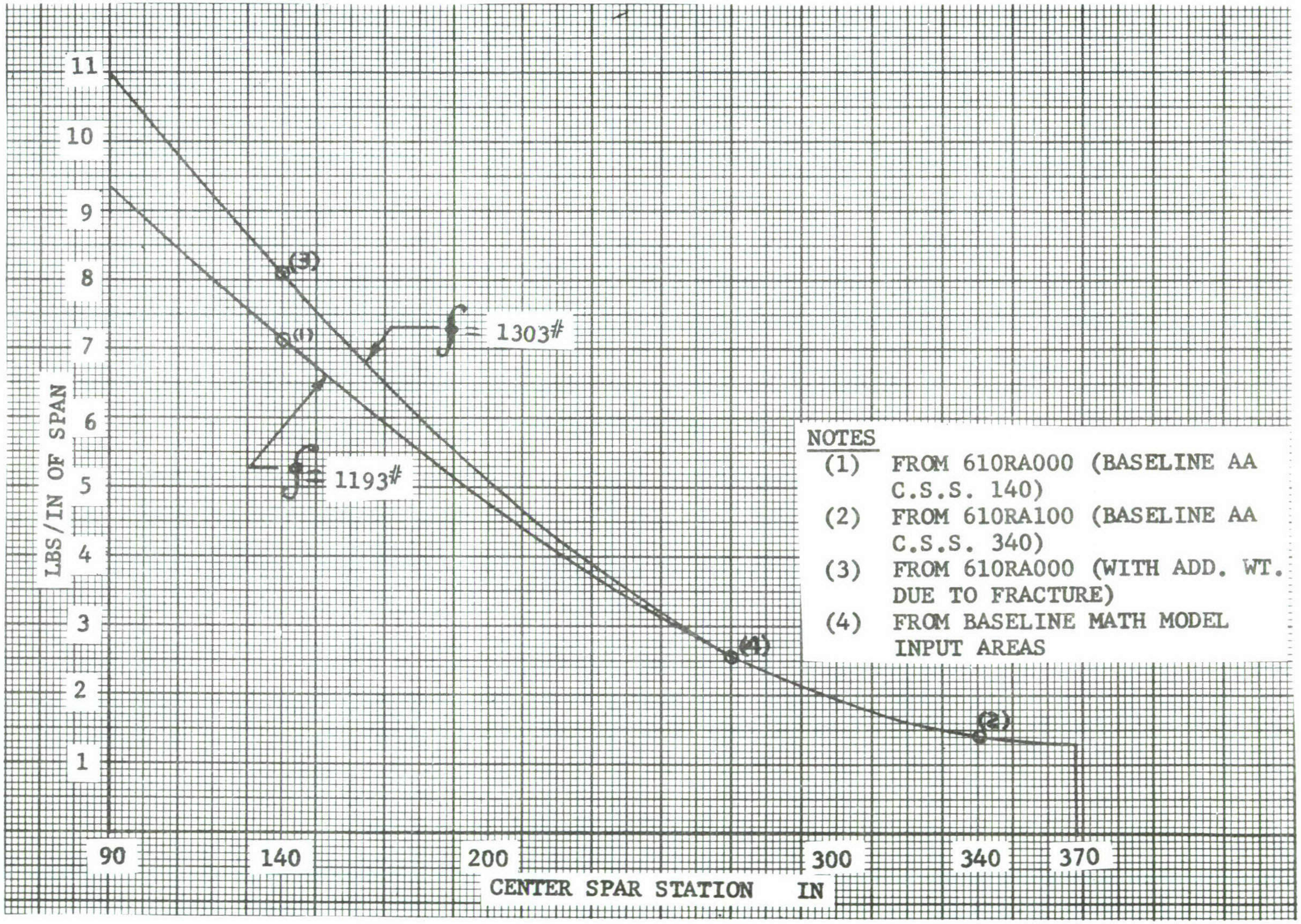


Figure 4 - Baseline Wing Structure Weight

Table XXIX

EFFECT OF LOWER SKIN DESIGN STRESS ON WEIGHT

Pylon Provision Identifiable Weights	= 244.4 Lbs.
Bhd Identifiable Weights	= 48.5
Identifiable Sealant and Finishes Weights	= 20.2
H. Lift Track & Splice Provisions (Balance)	= 41.8
Recurring Weight	= 354.9 Lbs

Using "Analytical Assembly" Weights at CSS 140 & 340

a) $\dfrac{7.17^{(1)} + 1.44}{2}(278) = 1197$

$$\begin{array}{r} 1197 \\ \underline{354.9} \\ 1551.9 \text{ Lbs} \end{array}$$

b) $\dfrac{8.02^{(2)} + 1.44}{2}(278) = 1315$

$$\begin{array}{r} 1315 \\ \underline{355} \\ 1670 \text{ Lbs} \end{array}$$

$\Delta W = 118$ lbs

Notes:

(1) 47.8 KSI (Ult)

(2) 39 KSI (Ult), 20.7 KSI @ 15.5 (10^6) in-lbs

Table XXX

EFFECT OF LOWER SKIN DESIGN STRESS ON WEIGHT

Variation of "Analytical Assembly" Weight with respect to lower surface design allowable stress,

$$\frac{40.51/48}{47.8 - 39.0} = .096 \ \frac{\text{Lbs/In}}{\text{KSI}}$$

Assembly	$S_{Allow.(Ult)}$	Weight at CSS 140
610RA 000 (Basic)	47.8 KSI	7.17 Lbs/In
610RA 000 (With Add)	39.0	8.02
Using .096 $\frac{\text{Lbs/In}}{\text{KSI}}$	:30.0	8.88
" " "	:20.0	9.84

Using the technique shown previously (a & b, TABLE III)

c) $\frac{8.88 + 1.44}{2}(278) = \begin{array}{r} 1435 \\ 355 \\ \hline 1780 \text{ Lbs} \end{array}$

d) $\frac{9.84 + 1.44}{2}(278) = \begin{array}{r} 1568 \\ 355 \\ \hline 1923 \text{ Lbs} \end{array}$

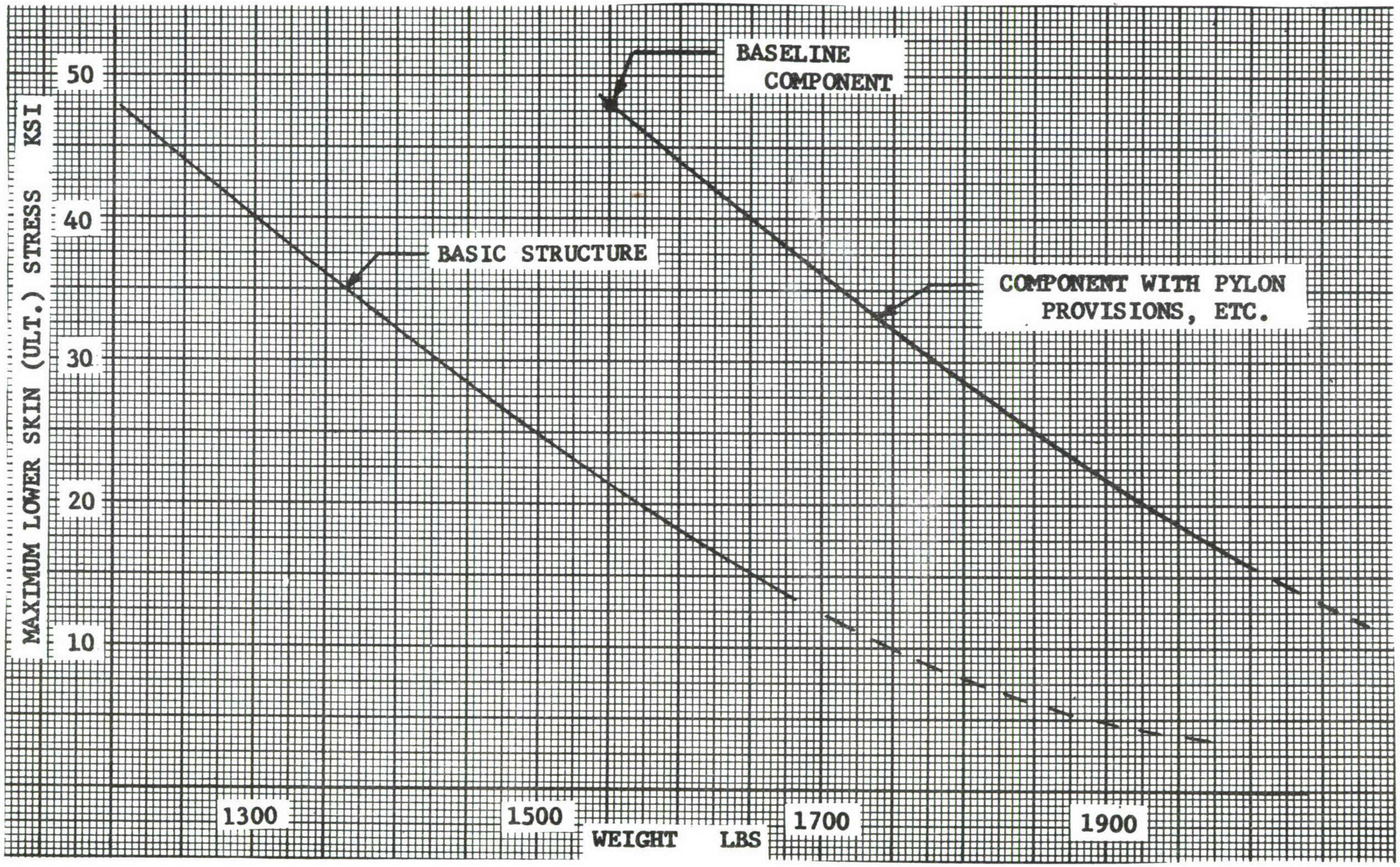


Figure 5 - Effect of Lower Skin Design Stress on Weight

discussed in paragraph IV.2.1.2.1 above. Cost data for the analytical assemblies were adjusted to remove the nonrecurring costs. Using this new cost, the price per inch of span was computed by dividing this new cost by forty-eight. This gave a figure identified as C_{CSS140} or C_{CSS340} depending on the location of the analytical assembly. A tentative figure was then calculated from the following formula:

$$C_{full\ wing} = C_{CSS140} \times 180'' + C_{CSS340} \times 89''$$

This tentative figure was then adjusted by a scaling factor computed using the baseline cost data. This factor was obtained by calculating "$C_{full\ wing}$" using cost data from 610RA000 and 610RA100 in the above formula and dividing it into the known cost of the baseline wing ($64,283, reference Appendix VII, Baseline Definition, Cost Description).

Using this technique, preliminary screening costs were obtained for evaluating configurations in the A/A matrix.

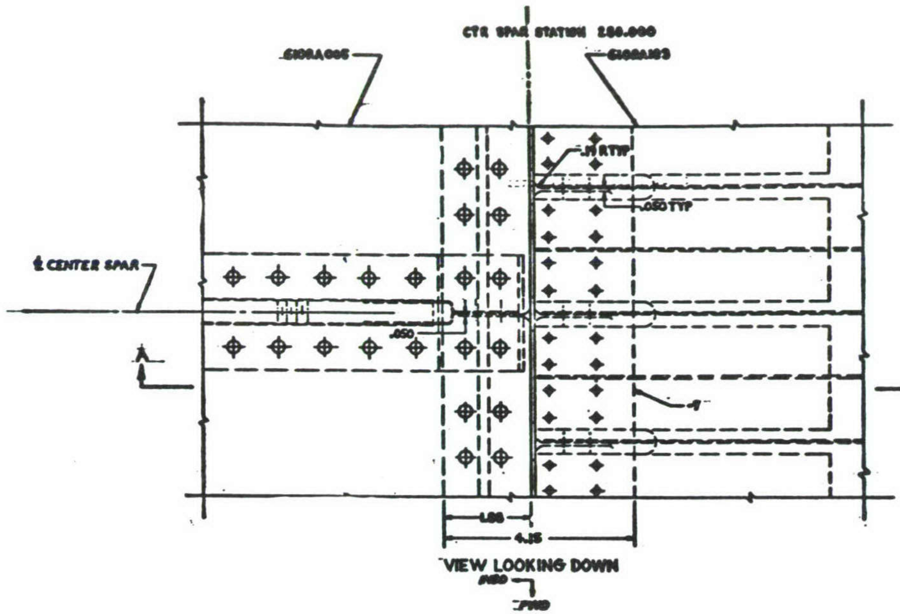
IV.2.2 Splice Designs

IV.2.2.1 Purpose of the Splices

Analytical Assemblies were developed for different designs for CSS 140 and CSS 340. The important design parameters vary from CSS 140 where the more critical parameter is bending to CSS 340 where the more critical consideration is pressure. Because of this variation, any particular concept which meets the design parameters od one CSS location, may not be the type of structure ideally suited to satisfy the considerations at the second CSS location. For this reason, a design study was conducted to investigate the splicing of two different type structures to form one full wing box structure. From this work a Trade Study was made. Figures 6 through 9 show the four splices considered. These four combinations represent optimum potential weight savings based on Analytical Assembly data.

IV.2.2.2 Weight Estimates of the Splices

The delta weights incurred in each splice were calculated and were tabulated on the drawings. The two lightest splices were selected for use in the preliminary design of two additional full wing box configurations. Only those items unique to the splice were included in the weight calculation.



DASH NO.	PART NAME	NO. REQD	RAW STK SIZE	MATERIAL	RAW STK WEIGHT	FINAL WEIGHT	COST
-7	BULKHEAD	1	CASTING*	356-T6 AL	7.500#	6.119#	
C387V4-7	BOLT	50				.335#	
C520-428-4	NUT	50				.315#	
C020-6-2	SHEAR PIN	55				.0990	
C2950-6	NUT	55				.0660#	
C388V4-6	BOLT	50				.3700#	
C389-4	NUT	50				.1590#	
C088-4	RIVET	198				.0400#	

TOTAL = 7.503#
610RA005 UPR & LWR SKIN WT INCREASE = 3.564#
TOTAL WT = 11.067#

* FINISH MACHINING REQD FOR CONTOUR AND SPAR ATTACHEMENT LOCATIONS

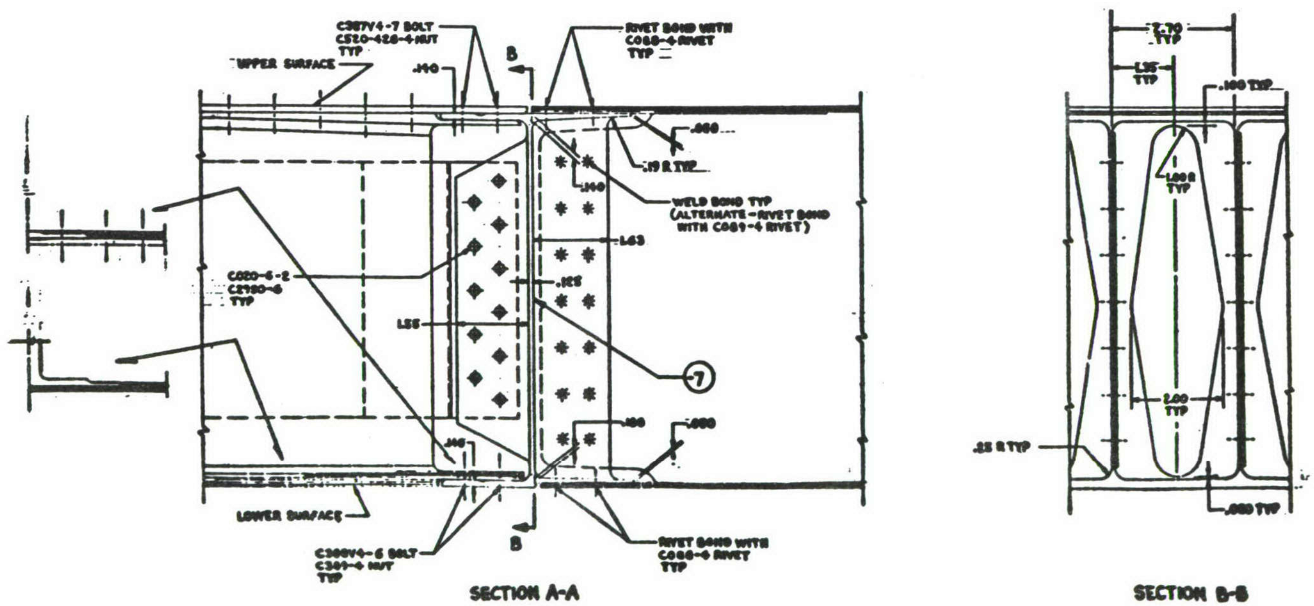
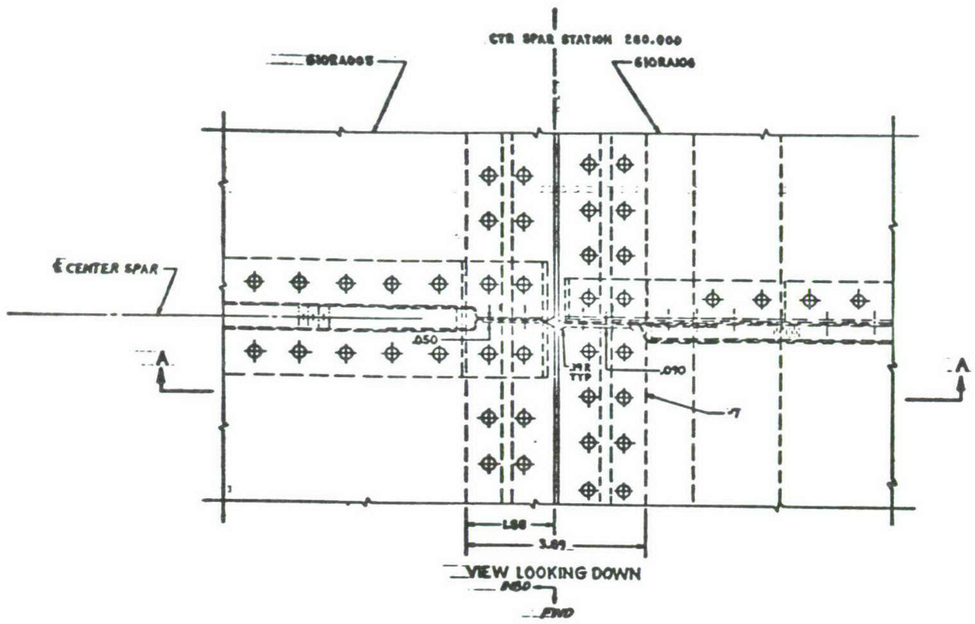


Figure 6 Preliminary Splice Design Concepts 610RA005 and 610RA103



DASH NO.	PART NAME	NO. REQD	RAW STK SIZE	MATERIAL	RAW STK WEIGHT	FINAL WEIGHT	COST
-7	BULKHEAD	1	CASTING*	356-T6 Al	7.500#	5.860#	
C38TV4-7	BOLT	116				.777#	
C520-428-4	NUT	116				.731#	
C020-6-2	SHEAR PIN	55				.099#	
C020-6-3	SHEAR PIN	42				.068#	
C2950-6	NUT	97				.116#	
C386V4-6	BOLT	116				.858#	
C389-4	NUT	116				.369#	

TOTAL = 8.906#
610RA005 UPR & LWR SKIN WT INCREASE = 3.564#
610RA106 UPR & LWR SKIN WT INCREASE = 2.082#
TOTAL WT = 14.552#

* FINISH MACHINING REQD FOR CONTOUR AND SPAR ATTACHMENT LOCATIONS

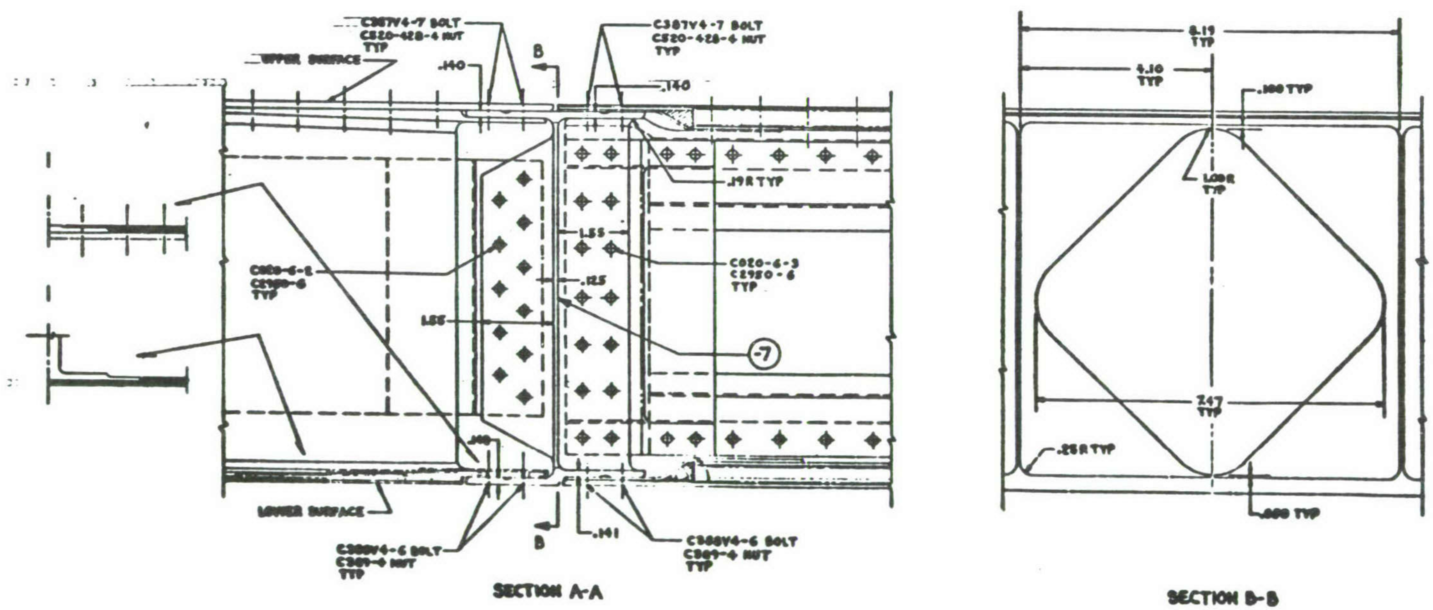
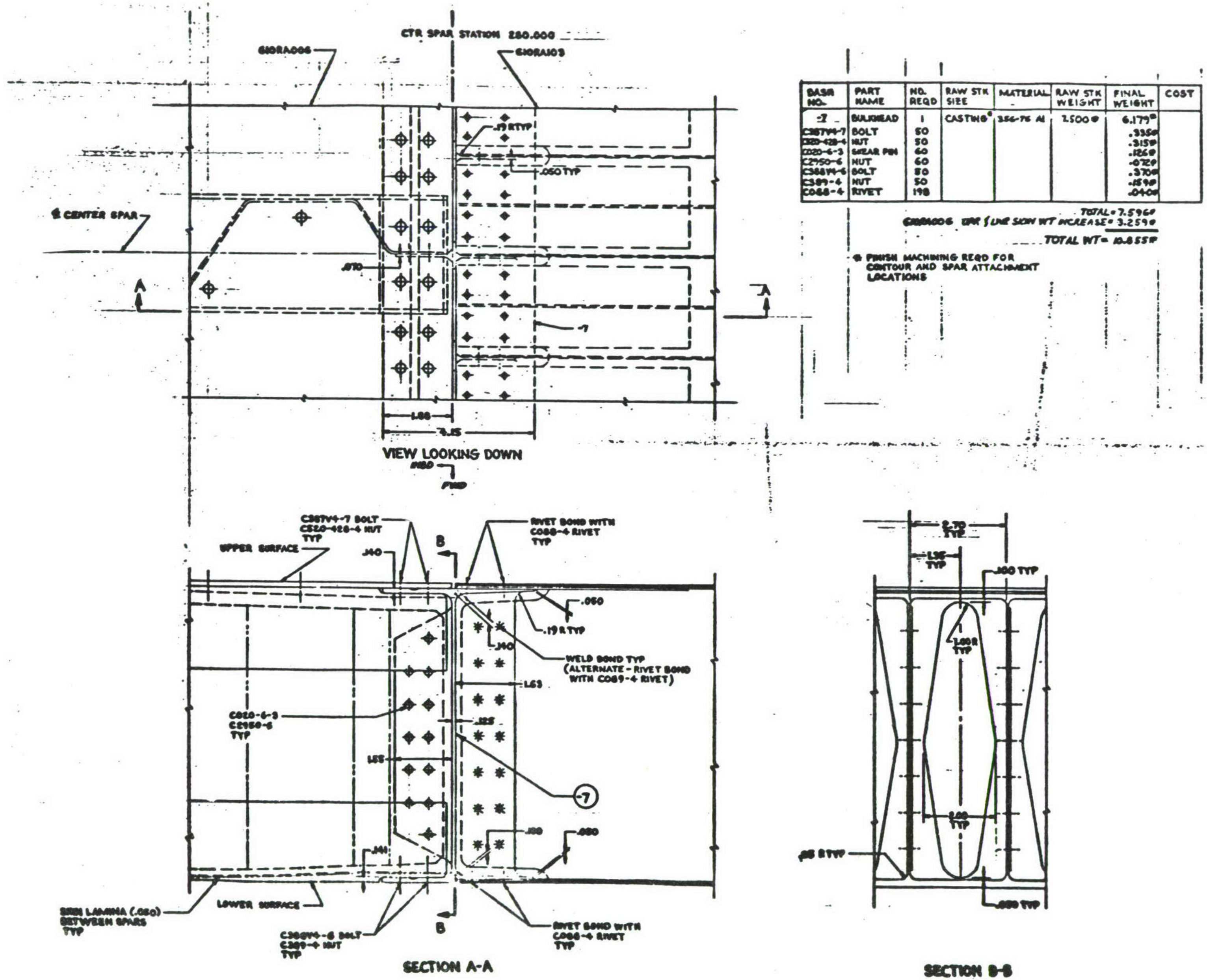


Figure 7 Preliminary Splice Design Concepts 610RA005 and 610RA106



BASA NO.	PART NAME	NO. REQD	RAW STK SIZE	MATERIAL	RAW STK WEIGHT	FINAL WEIGHT	COST
-7	BULKHEAD	1	CASTING*	356-T6 Al	2.500#	6.179#	
C38TV4-7	BOLT	50				.335#	
C520-428-4	NUT	50				.315#	
C020-6-3	SHEAR PIN	60				.126#	
C2950-6	NUT	60				.072#	
C38BV4-6	BOLT	50				.370#	
C389-4	NUT	50				.159#	
C068-4	RIVET	198				.040#	

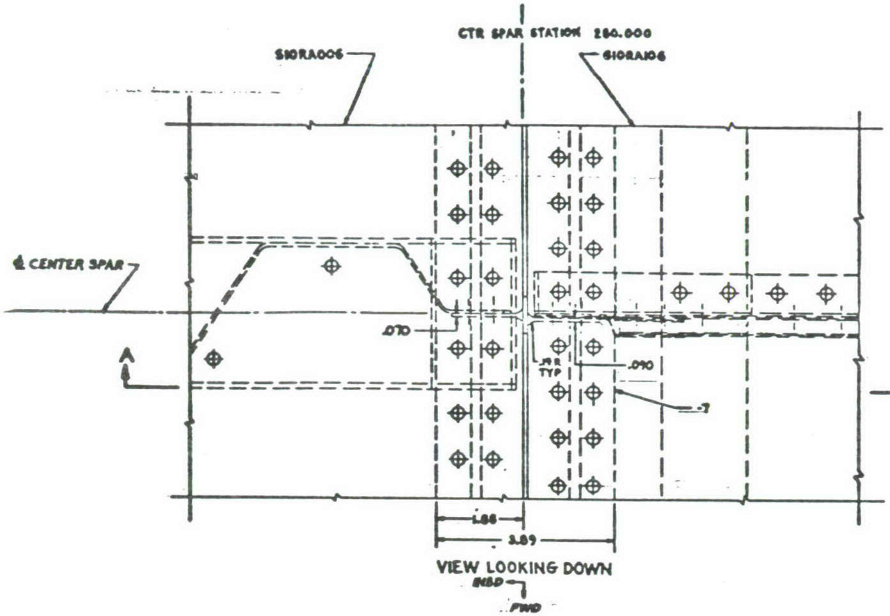
TOTAL = 7.596#

610RA006 UPR / LWR SKIN WT INCREASE = 3.259#

TOTAL WT = 10.855#

* FINISH MACHINING REQD FOR CONTOUR AND SPAR ATTACHMENT LOCATIONS

Figure 8 Preliminary Splice Design Concepts 610RA006 and 610RA103



DASH NO.	PART NAME	NO. REQD	RAW STK SIZE	MATERIAL	RAW STK WEIGHT	FINAL WEIGHT	COST
-7	BULKHEAD	1	CASTING*	356-T6 Al	7.500#	5.931*	
C38TV4-7	BOLT	116				.777#	
C520-428-4	NUT	116				.731#	
C020-6-3	SHEAR PIN	102				.214#	
C2950-6	NUT	102				.122#	
C388V4-6	BOLT	116				.858#	
C389-4	NUT	116				.369#	

TOTAL = 9.002#
610RA006 UPR & LWR SKIN WT INCREASE = 3.259#
610RA106 UPR & LWR SKIN WT INCREASE = 2.082#
TOTAL WT = 14.343#

* FINISH MACHINING REQD FOR CONTOUR AND SPAR ATTACHMENT LOCATIONS

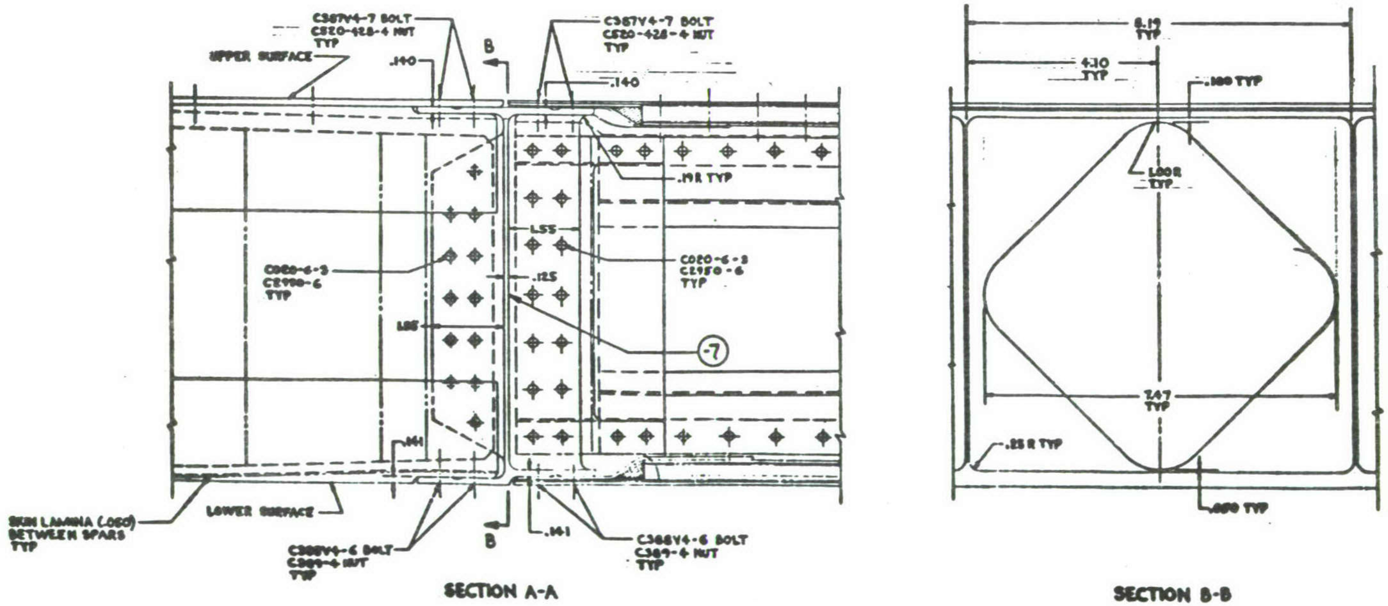


Figure 9 Preliminary Splice Design Concepts 610RA006 and 610RA106

IV.2.2.3 Cost Estimates for Splices

The delta costs for manufacturing and installing each splice were estimated using procedures established by Value Engineering for this program. These costs are shown in Table XXXI.

Table XXXI

SPLICE STRUCTURAL EFFICIENCY DATA

FIGURE	DRAWING COMBINATIONS	COST	WEIGHT	REMARKS
3	610RA005 and 610RA103	$767.12	11.067 lbs	Used in 610RW008
4	610RA005 and 610RA106	$747.49	14.552 lbs	-
5	610RA006 and 610RA103	$737.93	10.855 lbs	Used in 610RW009
6	610RA006 and 610RA106	$715.64	14.343 lbs	--

IV.2.3 Discussion of Configuration

The top rated wings selected from the Analytical Assembly Matrix evaluation were used to generate full wing box configurations. A total of nine (9) designs were completed during this portion of the program. Pertinent data on each design is discussed below. Copies of each drawing are shown in Section IV.5.

IV.2.3.1 Drawing 610RW000, Baseline Update

A special drawing was prepared to accurately assess the impact of the new damage tolerance criteria on the baseline wing box. This drawing shows the skin thickness increases necessary to lower the effective stress levels. As discussed in paragraph IV.2.1.2, it also served as a check of the weight estimation techniques. There was no change in the baseline materials.

IV.2.3.2 Drawing 610RW001

This configuration utilized a laminated aluminum lower skin, a sandwich upper skin, integrally stiffened machined spars, and pressure straps in the outboard portion. All components are 7050 aluminum.

The spar caps are integral with the upper and lower skins to position them as far from the neutral axis as possible. The lower spar caps have the added advantage of being accessible to the outer surface. This enhances the inspectability of the spar caps.

There are no fastener penetrations through the bending material of the lower skins. Fasteners are eliminated to reduce K_T (stress concentration factor) and permit designing to higher operation stresses which results in weight savings.

Lower skins are laminated to acieve a decrease in crack growth rate. Laminates and planks create multiple load paths for a fail safe lower skin configuration.

Beginning at approximately CSS 270 a series of tension straps have been used to react the fuel pressure loads. These straps also increase the stiffness of the wing with a minimum penalty.

IV.2.3.3 <u>Drawing 610RW002</u>

A special full depth titanium core with fuel flow capabilities is the unique feature of this design. A laminated and planked lower skin is used to improve its damage tolerance and provide multiple load paths. The entire assembly, upper skin, lower skins, and core, is brazed using a low temperature braze alloy in order to allow use of the alloys at their maximum strength condition. Fasteners are eliminated through the lower panel bending material in order to reduce K_T. The low K_T configuration in combination with the reduced crack growth rate from the brazed laminated lower skin permits sizing to an operating stress of 92,500 psi.

This design was the lightest configuration of all nine concepts and was the second most expensive concept.

IV.2.3.4 <u>Drawing 610RW003</u>

This concept was rated the number one configuration by the merit rating system. It employes an etched solid plate upper skin for economy and a laminated and planked lower skin for damage tolerance and multiple load paths. The spars use a corrugated web design which provides good compression stability for the upper panel. All components are also integral and accessible as discussed in paragraph IV.2.3.2. Fasteners are eliminated through lower surface bending material to achieve low K_T and the weight savings made possible by this design approach.

IV.2.3.5 Drawing 610RW004

Sandwich panel skins are used for both the upper and lower skins in this design. Spar cap material is integral with the skins. Spar webs are built up using weld-bonded stiffeners. All parts are of 7050 aluminum. Fasteners are eliminated through lower surface bending material.

This design was costed using conventional fasteners through the upper panel and using pull-type permanent blind fasteners. It was found that use of blind in lieu of conventional fasteners would result in a cost savings of approximately $1600 for this design. By designing safe life, non inspectable structure, this configuration ranked high.

IV.2.3.6 Drawing 610RW005

This design was similar to 610RW004 (reference paragraph IV.2.3.5) except all components were titanium instead of aluminum. This provided a significant weight reduction but doubled the cost.

IV.2.3.7 Drawing 610RW006

This configuration uses a three dimensional space truss brazed to titanium skins. It provides good stability and light weight but was the most expensive concept considered. The design takes advantage of weight savings made possible by eliminating lower skin panel fasteners, brazed laminates and planks plus low temperature brazing that results in maintaining maximum F_{tu} for titanium alloys.

IV.2.3.8 Drawing 610RW007

This concept is very similar to 610RW003; the major difference being the addition of hat stiffeners to the upper skin. The lower skin used the same laminated concept as 610RW003.

IV.2.3.9 Drawing 610RW008

This configuration uses the splice concept discussed in paragraph IV.2.2.1. The splice shown in Figure 6 was used to modify drawing 610RW007 by adding the multi-spar concept as the tip concept (reference drawing 610RA103).

IV.2.3.10 Drawing 610RW009

This drawing also utilizes a splice (reference Figure 8) to modify drawing 610RW003 by adding the multi-spar concept as the tip concept.

IV.3 EVALUATION AND RANKING

The evaluation and ranking of each configuration is an important part of the design approach used in this program. The objective of this system is to remove personal opinion which may influence a design and to insure that each discipline area has an opportunity to influence the design rating.

IV.3.1 Discussion of Rating System

The rating system used in evaluating and ranking the analytical assembly drawings is identical to that used for the cross-section concepts except for rating values for structural integrity. A complete discussion of the approach used to implement the rating system is contained in Appendices II, "Cross-Section Drawings". The revised rating values for structural integrity changed safe crack growth from 0.2 to 0.3 and multiple load path from 0.4 to 0.3. Multiple load path was also redesignated as Fail Safe. The basic elements of the revised rating system are shown in Table XXXI.

IV.3.2 Evaluation of Concepts

During the Preliminary Design phase of this program, nine (9) preliminary drawings were made. These drawings are included in Section IV.5. The evaluation of these designs is discussed below and is summarized in Table XXXIII.

IV.3.2.1 Structural Efficiency

The weight and cost totals and the evaluation score for each configuration are shown in Table XXXIII. The weight and cost values are based on a complete wing box and were computed using the procedures described in paragraph IV.2.1.2.

To assure that cost data for each configuration was comparable, the following costing ground rules were established:

- o 1972 rates were used. No escalation factors were used.
- o Unit cost was based on a total aircraft production of 506 at a rate of 20/month.

Table XXXII

RATING SYSTEM FOR THE

ADVANCED AIR SUPERIORITY FIGHTER WING STRUCTURES PROGRAM **

STRUCTURAL EFFICIENCY = 0.3	TECHNOLOGY ADVANCEMENT = 0.3	INTEGRITY AND RELIABILITY = 0.3	ABILITIES = 0.1
Cost = 0.5	Concepts = 0.3	Static = 0.1	Inspectability = 0.5
Weight = 0.5	Manufacturing = 0.3	Fatigue = 0.3	Manufacturability = 0.2
	Materials = 0.3	Safecrack = 0.3	Maintainability = 0.1
	Fracture = 0.1	Fail Safe = 0.3	Repairability = 0.1
			Predictability = 0.1

* Service Life maintained at 4000 flight hours. Any design not maintaining this life will be considered unacceptable.

** Revised rating system Jan 1973.

Table XXXIII

PRELIMINARY DESIGN CONCEPTS—EVALUATION SUMMARY

CONFIG. NO.	DESCRIPTION	STRUCT. EFFICIENCY		TECHNOLOGY ADVANCEMENT				STRUCT. INTEGRITY-RELIABILITY				ABILITIES					TOTAL SCORE	RANK
		COST (.15)	WEIGHT (.15)	CONCEPT TECH (.09)	MFG. TECH (.09)	MATL'S TECH. (.09)	FRACT. TECH. (.03)	STATIC (.03)	FATIGUE QUALITY (.09)	SAFE CRACK (.09)	FAIL SAFE (.09)	INSPECT (.05)	MFG. (.02)	MAIN-TAIN (.01)	REPAIR (.01)	PREDICT (.01)		
610RW000	F-111F BASELINE (MODIFIED)	64,283 .140	1684.2 .091	.009	0	0	.012	.030	.041	.041	0	.050	.020	.010	.010	.0039	.4579	10
610RW001	SANDWICH UPR. SKIN, LAM LWR SKIN WITH TENSION STRAPS OUTBD (ALUM)	98,774 .091	1335.0 .115	.063	.0387	.045	.024	.017	.088	.090	.090	.039	.0124	.0084	.009	.0058	.7363	6
610RW002	MULTI-WET CELL, BRAZED TITANIUM	140,069 .064	1020.0 .150	.090	.090	.090	.024	.017	.087	.075	.025	.0344	.0122	.0071	.0056	.0061	.7774	4
610RW003	LAM. LWR. SKIN W/STEPPED SPAR CAPS: PLATE UPR, CORR. SPAR WEBS AL.	70,965 .1269	1345.0 .1138	.086	.0252	.0675	.024	.017	.088	.090	.090	.0375	.0160	.0097	.009	.0061	.8067	1
610RW004	ADHESIVE BONDED AL. HONEYCOMB PANELS	60,027 .150	1340.0 .1142	.081	.0182	.0675	.030	.017	.088	.090	.049	.0398	.0145	.0092	.010	.0017	.7801	3
610RW005	ADHESIVE BONDED TI. HONEYCOMB PANELS	130,294 .0691	1196.0 .1279	.072	.0269	.09	.030	.017	.089	.075	.041	.039	.0124	.0084	.009	.0058	.7125	8
610RW006	SPACE TRUSS, BRAZED TITANIUM	176,431 .0512	1084.0 .1411	.086	.0817	.0675	.024	.017	.085	.075	.041	.0355	.0128	.0073	.007	.0076	.7492	5
610RW007	LAM. LWR SKIN, HAT STIFFENED UPR. SKIN (ALUMINUM)	64,712 .1391	1375.0 .1113	.054	.038	.0675	.024	.017	.090	.090	.090	.031	.0132	.0097	.009	.0029	.7866	2
610RW008	LAM. LWR. HAT UPR/ SPLICED TO MULTI-SPAR BONDED ALUMINUM	64,828 .1389	1291.0 .1185	.087	.0454	.0675	.022	.017	.076	.090	0	.031	.0149	.0097	.009	.0029	.7298	7
610RW009	LAM. LWR, PLATE UPR/ SPLICE TO MULTI-SPAR BONDED ALUMINUM	71,019 .1268	1300.0 .1177	.088	.0303	.0675	.022	.017	.075	.090	0	.0375	.0154	.0097	.009	.0061	.7120	9

IV.3.2.2 Technology Advancement

To insure a thorough evaluation of each configuration for Technology Advancement, the results of each area within Technology Advancement are included in Table XXXIII.

IV.3.2.3 Integrity and Reliability

The evaluation results for "Integrity and Reliability" have been organized into Table XXXIII to assist in the evaluation.

IV.3.2.4 Abilities

The charts containing the results of evaluation of "Abilities" are shown in Table XXXIII also. An important segment accounting for one-half of the "Ability" rating is "Inspectability". The rating was determined using procedures generated for the Analytical Assembly phase.

IV.3.3 Ranking of Concepts

The results of all the evaluations discussed in paragraph IV.3.2 were tabulated in Table XXXIII. The results of the evaluation for each element of the rating system were added together to obtain a Total Score. The configurations were ranked numerically with the highest score ranked as number 1.

IV.4 SELECTION FOR OPTIMIZATION PHASE

The full wing configuration receiving the highest scores during the evaluation described in Paragraph IV.3.0 were chosen for use during the Preliminary Design Optimization Phase; the final step in the design approach being used in this program. Concepts chosen are identified in Table XXXIII by circling the rank number. The number two (2) concept was not chosen because of its similarity to the number one ranked concept leaving only four (4) configurations to be considered in this final evaluation.

Additional trade studies were made for these four designs. A more accurate weight determination plus a "grass-roots" bid exercise to define costs were made on each design. The results of these efforts are reported in Vol. I, SECTION IV.

SECTION IV.5

PRELIMINARY DESIGN DRAWINGS

610RW000

610RW001

610RW002

610RW003

610RW004

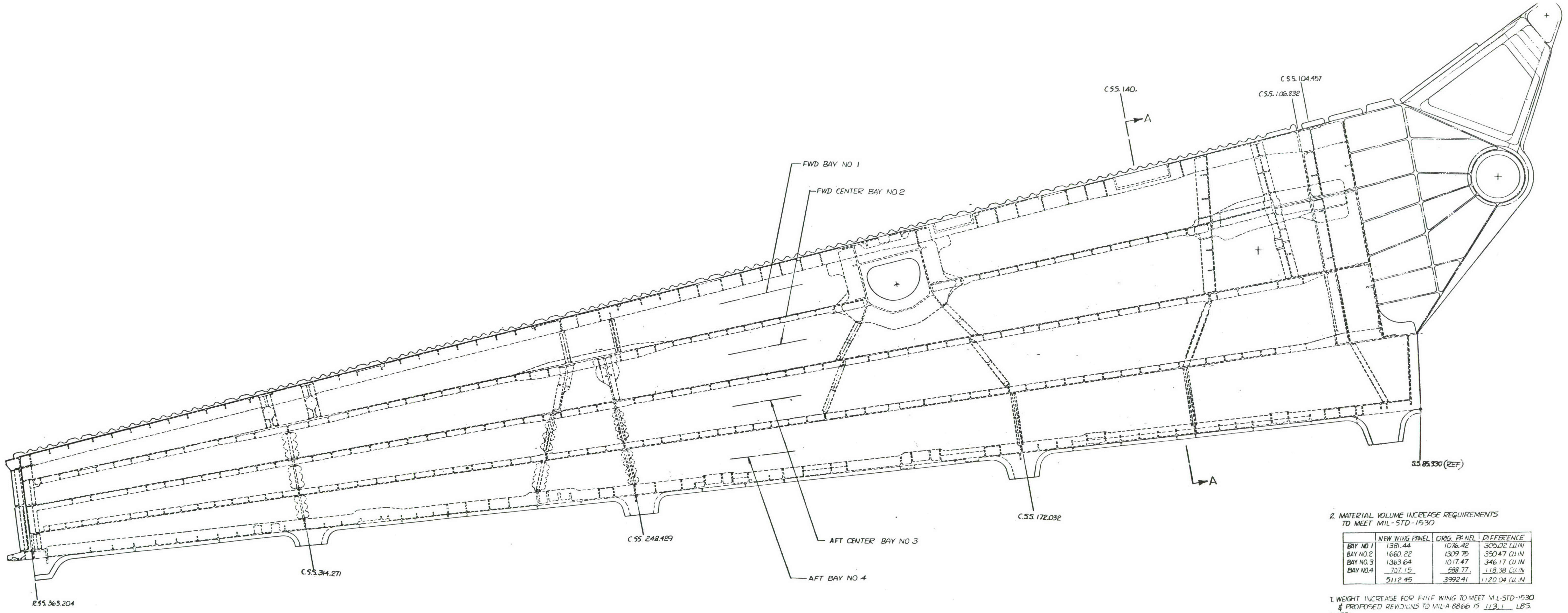
610RW005

610RW006

610RW007

610RW008

610RW009



2. MATERIAL VOLUME INCREASE REQUIREMENTS TO MEET MIL-STD-1530

	NEW WING PANEL	ORIG. PANEL	DIFFERENCE
BAY NO 1	1381.44	1076.42	305.02 CU.IN
BAY NO.2	1660.22	1309.75	350.47 CU.IN
BAY NO. 3	1363.64	1017.47	346.17 CU.IN
BAY NO.4	707.15	588.77	118.38 CU.IN
	5112.45	3992.41	1120.04 CU.IN

1. WEIGHT INCREASE FOR F-111F WING TO MEET MIL-STD-1530 & PROPOSED REVISIONS TO MIL-A-8866 IS 113.1 LBS.

NOTE:

PRELIMINARY DESIGN DRAWING

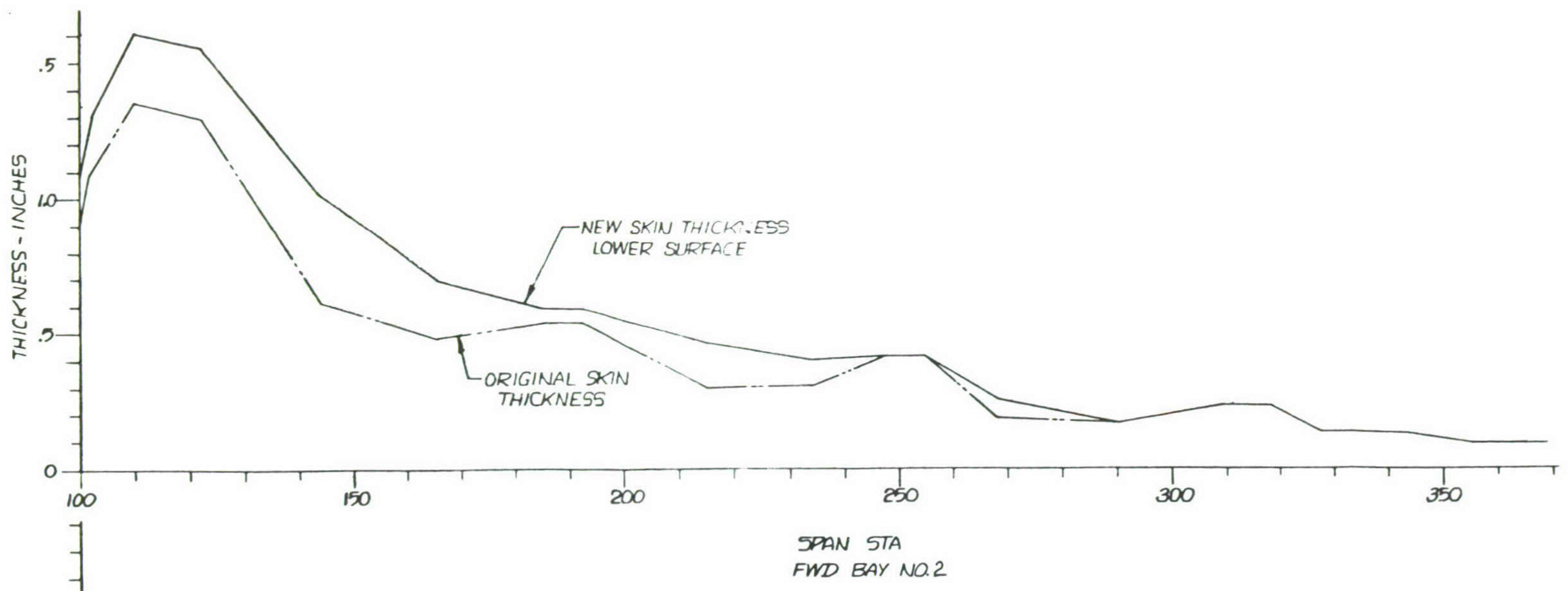
F111F BASELINE WING BOX - THICKNESS INCREASES TO MEET MIL-STD-1530 FRACTURE R...

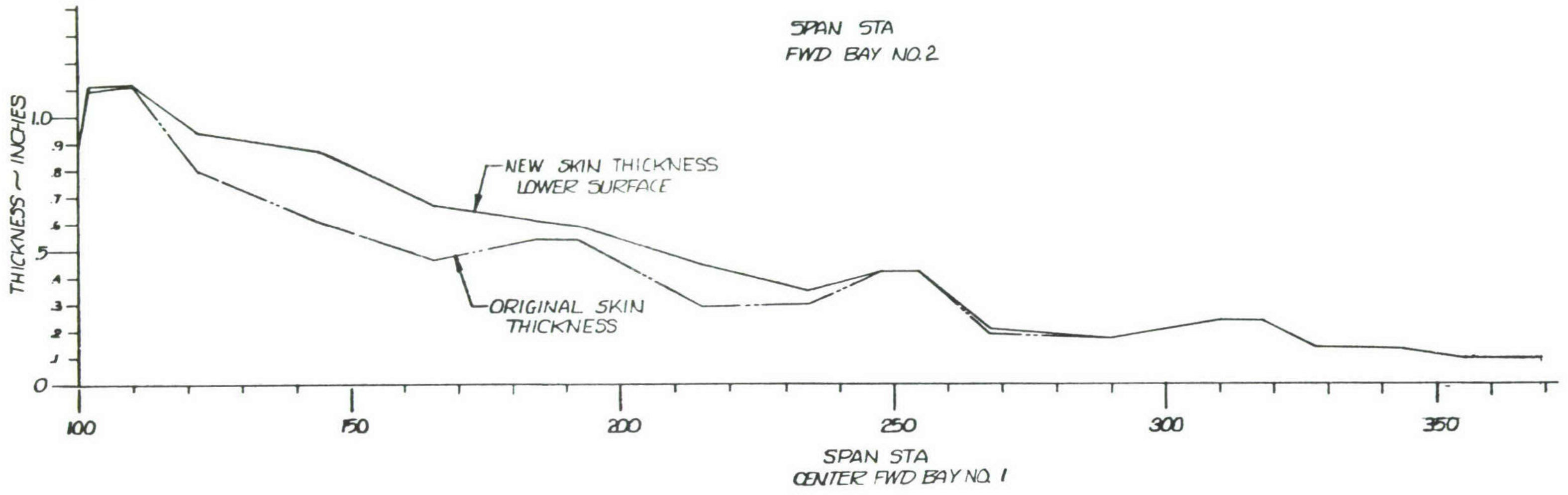
GENERAL DYNAMICS
Convair Aerospace Division

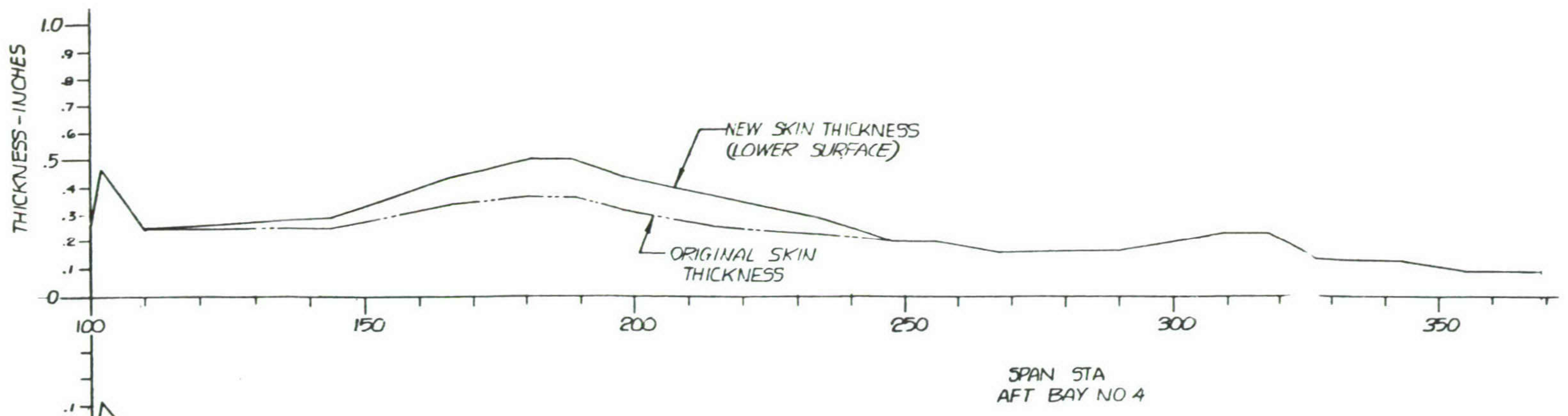
610RW000

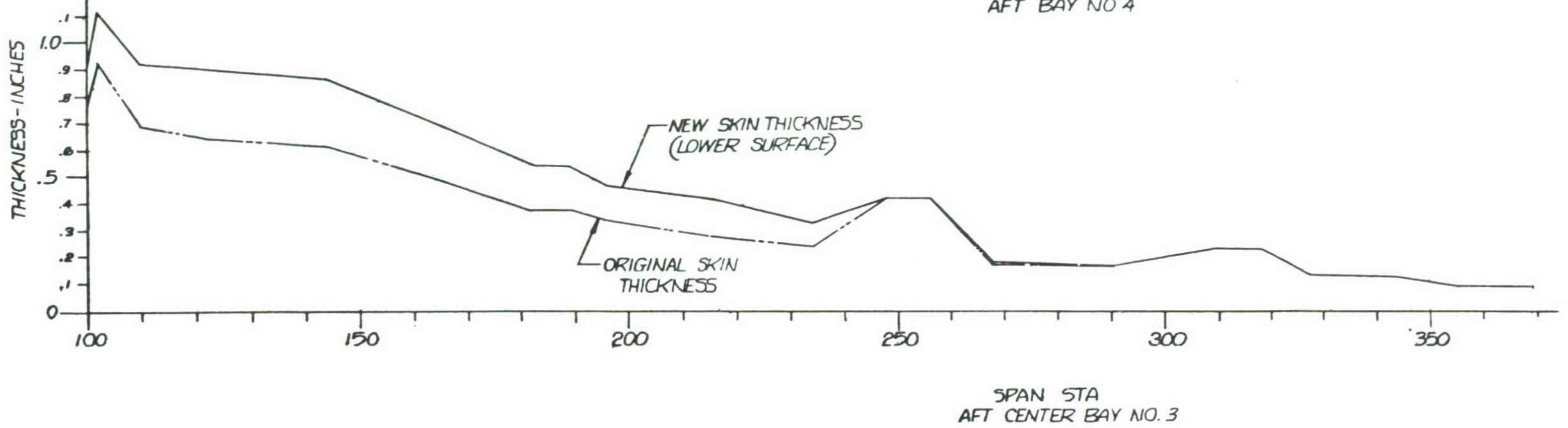
610RW000 Sheet 1

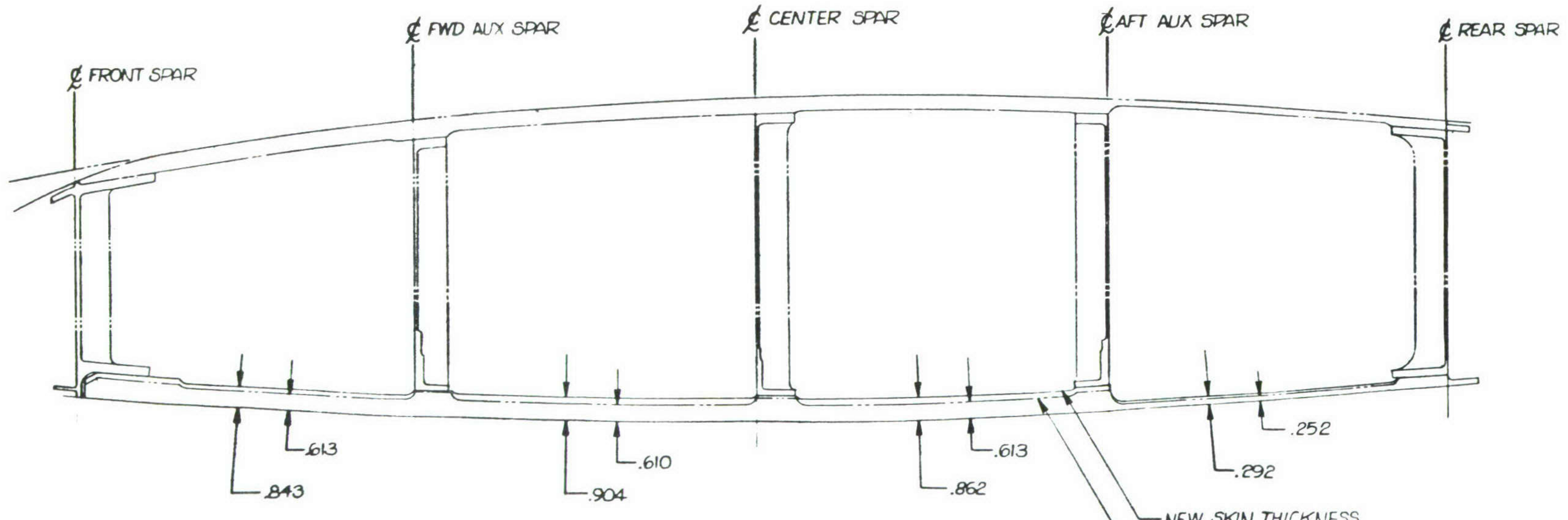
485/486





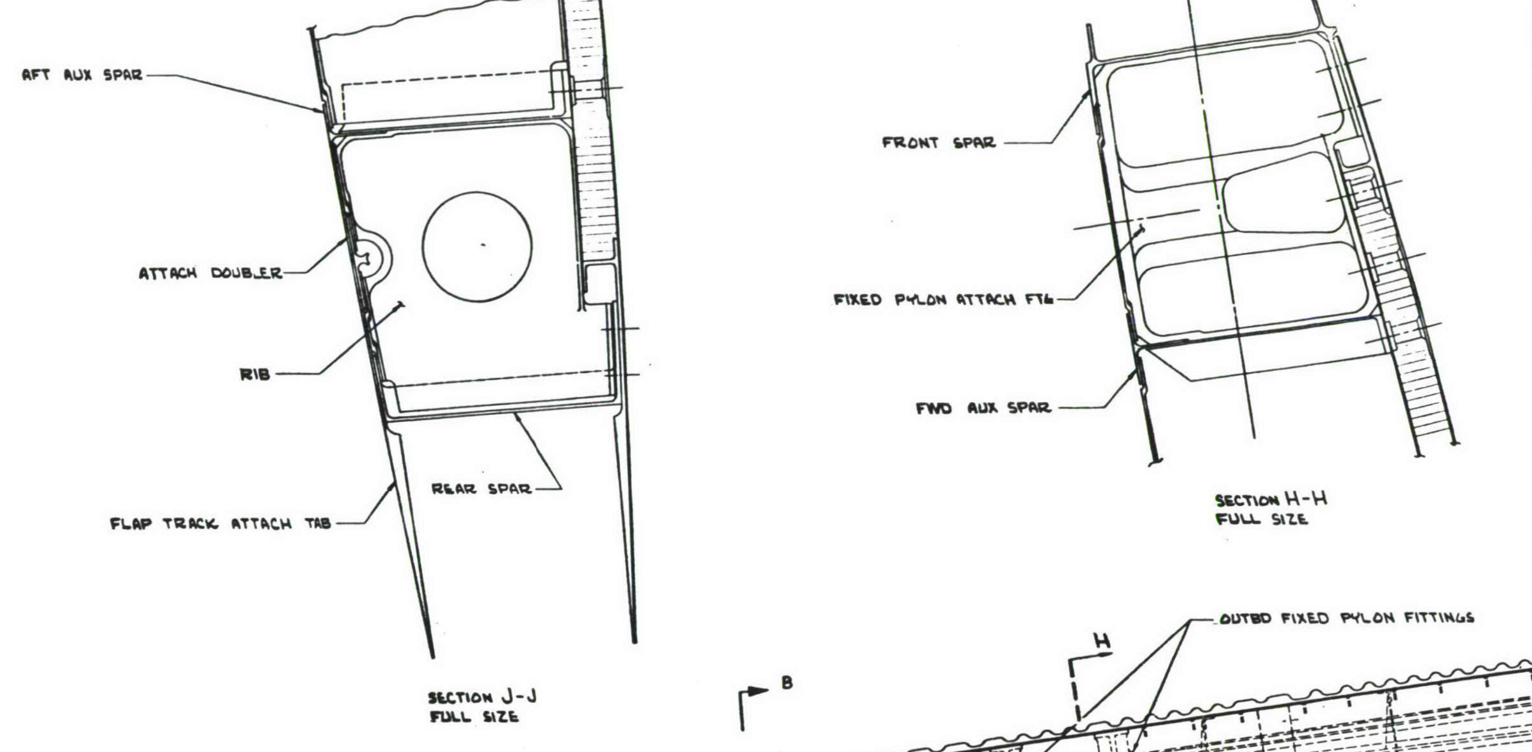






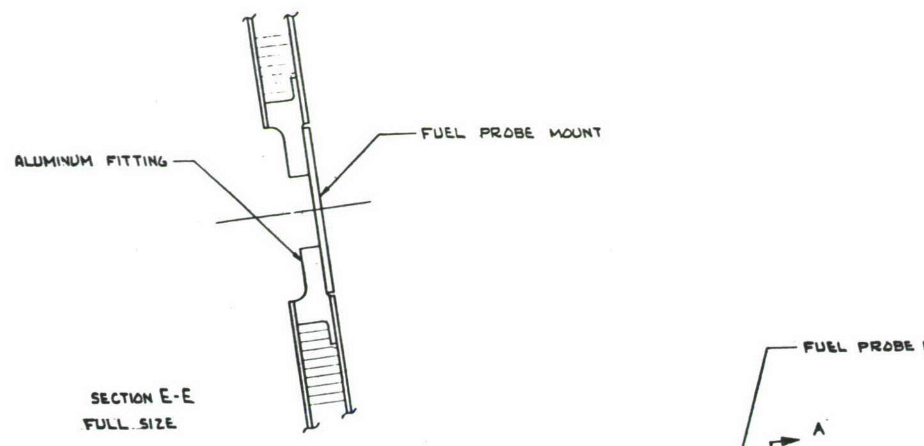
SECTION A-A
CSS 140 ROTATED 86°
COUNTERCLOCKWISE

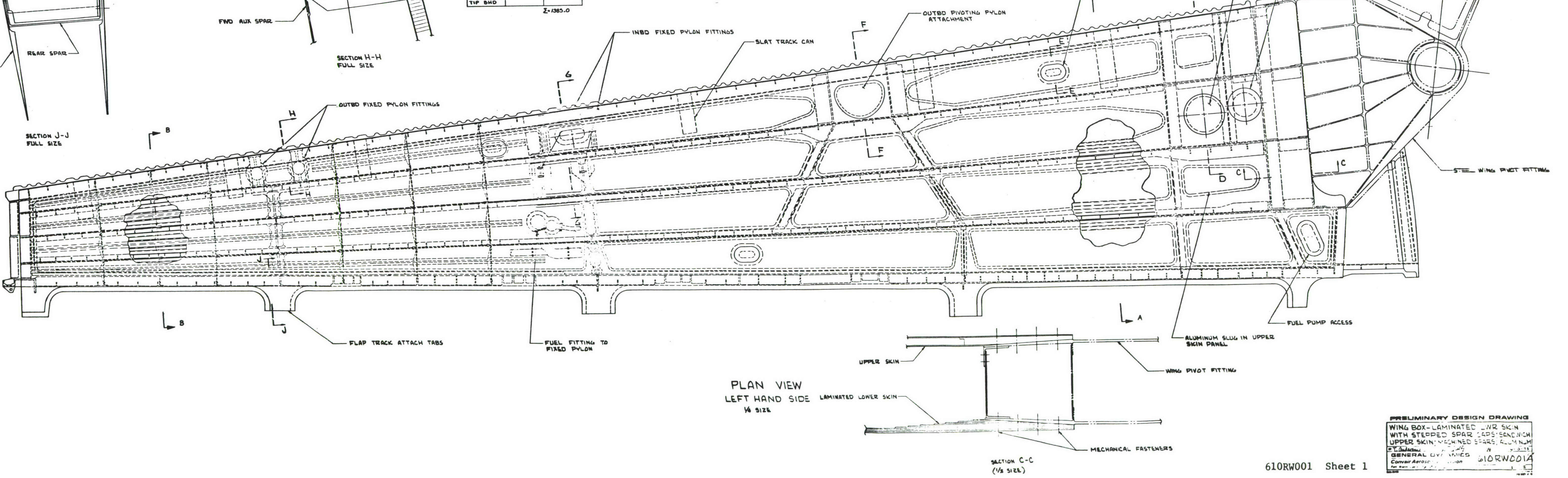
610RW000 Sheet 2



PART NAME	MATERIAL	FINISHED WEIGHT
SKINS SLUGS CORE	7050-T76 AL 7050-T76 AL AL	174.8 251.6 15.5
UPPER SKIN PANEL		441.9
LAMINATED LOWER SKIN	7050-T76 AL	200.3
FRONT SPAR	7050-T73651 (A)	74.4
FRONT AUX. SPAR		87.9
CENTER SPAR		76.2
AFT AUX. SPAR		73.1
REAR SPAR	7050-T73651 (A)	75.0
TENSION STRUTS	7050-T76 AL	1.2
SEALANT, PYLON ATTACH FITTINGS & BUILD-UPS, FLAP TRACK ATTACH BUILD-UPS, TIP BHD		355.0

$\Sigma = 1385.0$

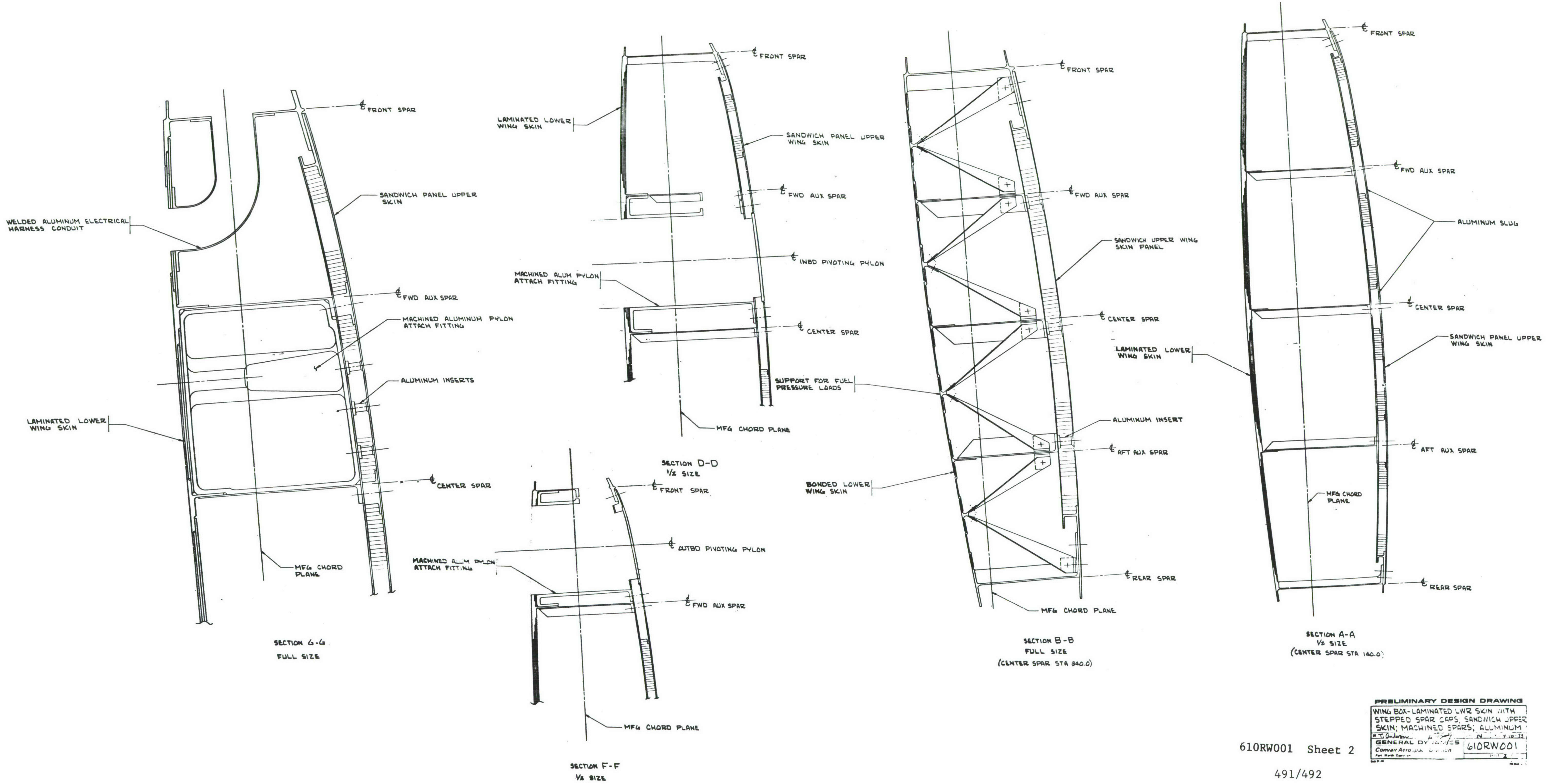




PLAN VIEW
LEFT HAND SIDE
1/6 SIZE

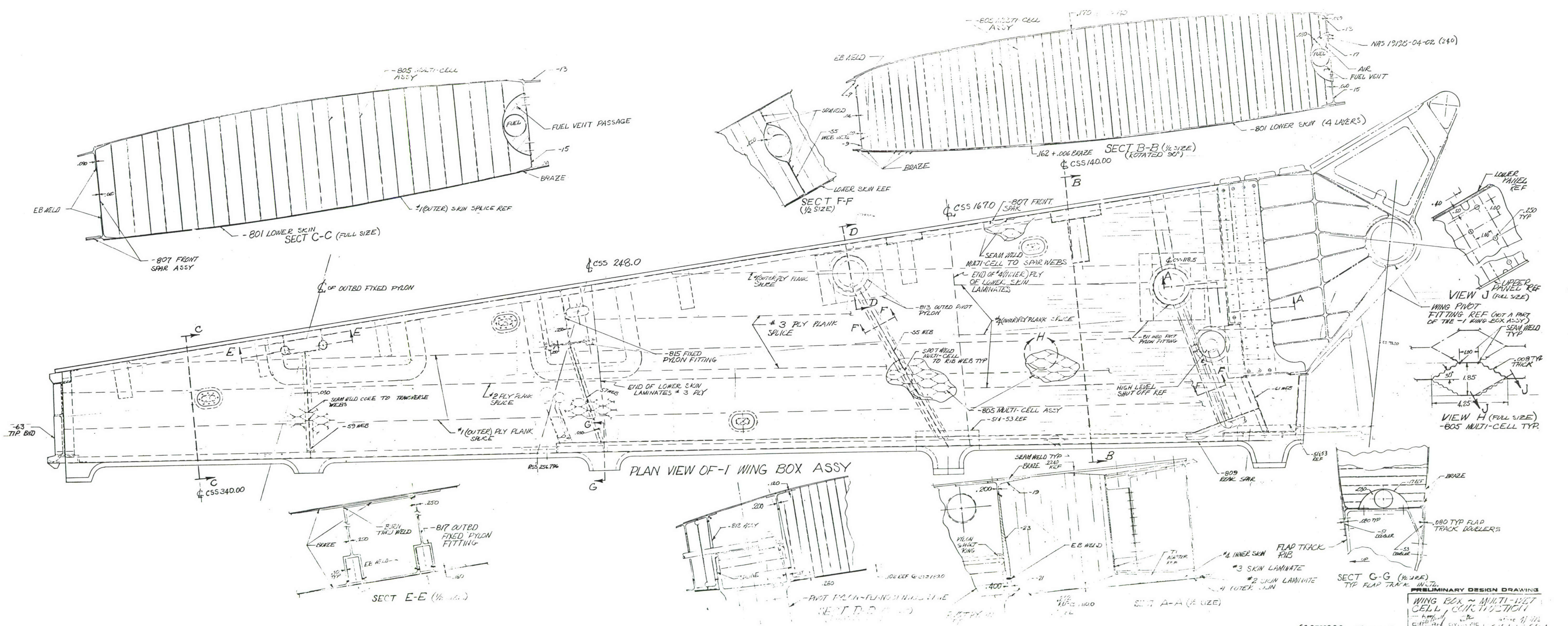
PRELIMINARY DESIGN DRAWING
WING BOX-LAMINATED LWR SKIN WITH STEPPED SPAR CAPS; SANDWICH UPPER SKIN; MACHINED SPARS; ALUMINUM
GENERAL DYNAMICS
Convair Aerospace Division
610RW001A

610RW001 Sheet 1



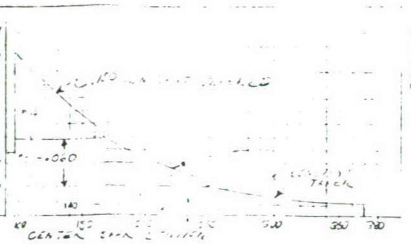
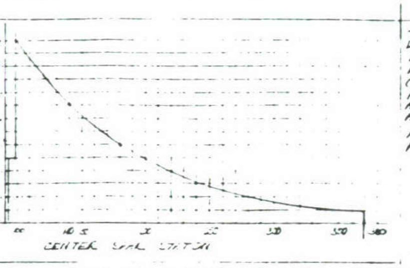
610RW001 Sheet 2

491/492

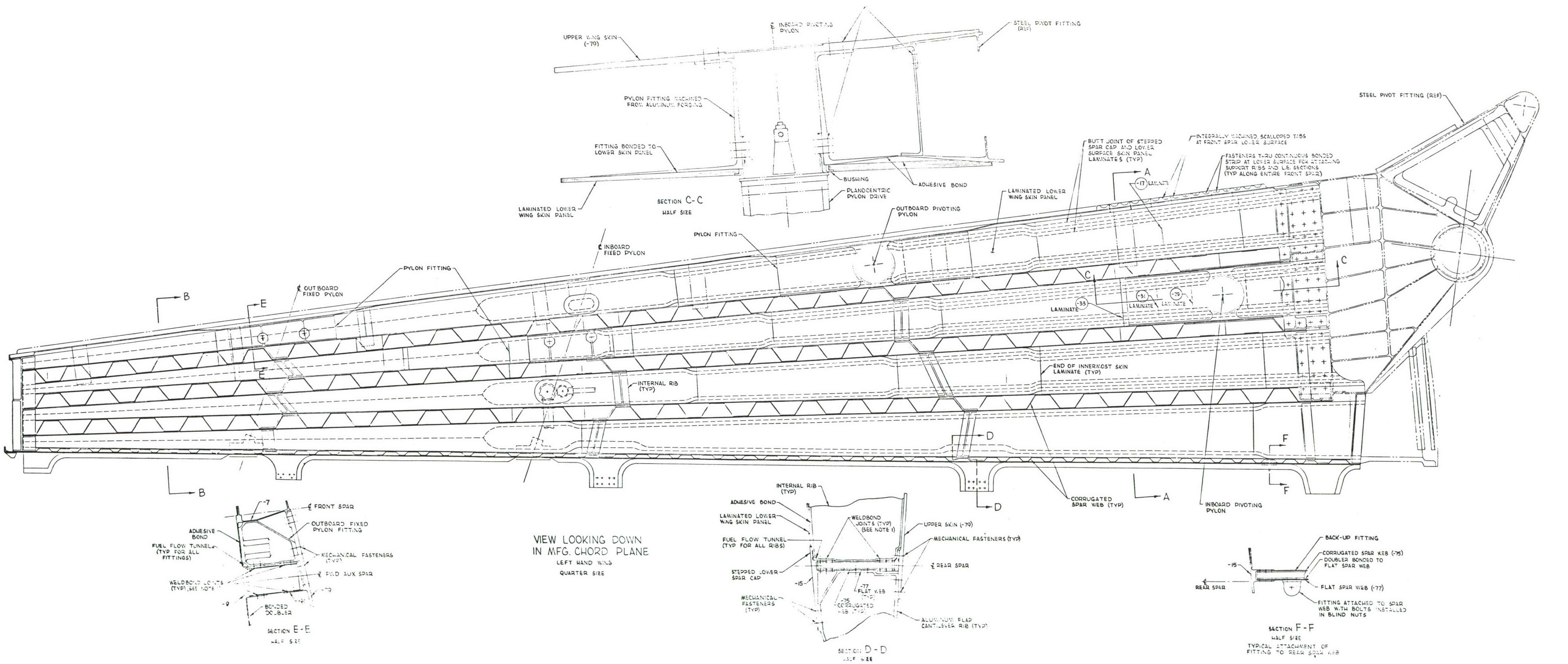


610RW002 Sheet 1

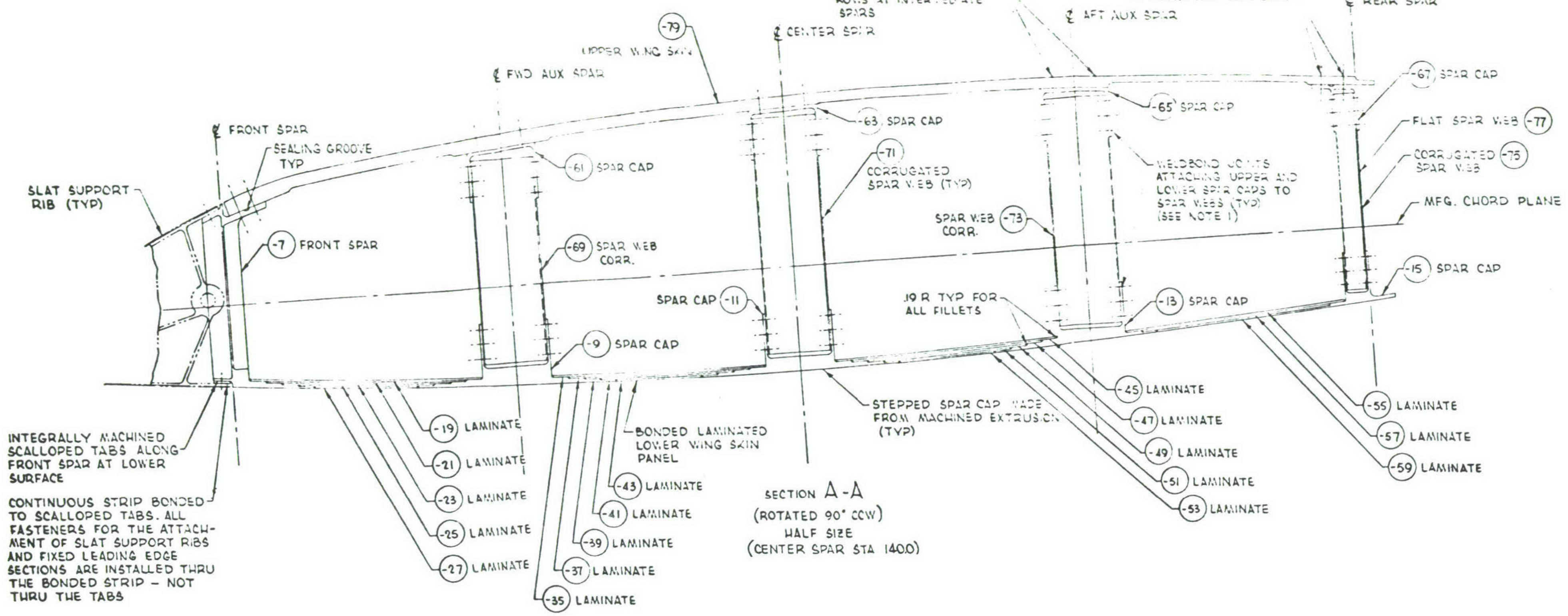
493/494

PART DRAWING NO.	PART NAME	PLOT OF AREA [illegible]	[illegible]	[illegible]	SIZE [illegible]	[illegible]	[illegible]
-801	[illegible] PARTS		[illegible] 3 [illegible] OF LAM[illegible]		[illegible]	[illegible]	2014 / 3[illegible].6
✓	BRAZE ALLOY	(TOTAL FOR EN[illegible] W[illegible])	(.23#/in²)	TX21	[illegible] 343	2.57	[illegible]
-803	UPPER SKIN		-803 SKIN IS CHEMICALLY TAPERED TO A THICKNESS CURVE THAT PRODUCES THE AREA CURVE AT LEFT. PROFILE PART FE[illegible]	6AL-4V TI (STA)	[illegible]	445#	216.0
-805	MULTI-CELL ASSY	TOTAL FINISHED VOLUME = 94,208 IN³	F[illegible] ELEMENTS [illegible] CONTOUR	COM. PURE TI	.00?x13.0 A.CE R[illegible] SHEET	197.0#	136.00
-807	FRONT SPAR ASSY		UPPER & LOWER CAPS ARE TI EXTRUSIONS MACHINED & WELDED TO WEB - [illegible] .05 [illegible] WEB [illegible] CHEM-[illegible]	6AL-4V STA TI	7EXR .98 in² x 280" / -9EXR .95 in² x 280" / -11 WEB .090 x 70 x 280	43.8# / 42.0# / 28.0	15.4# / 14.5# / 13.0
-809	REAR SPAR ASSY		UPPER & LWR CAPS ARE TI EXTR'NS MACHINED & WELDED TO [illegible]	6AL-4V STA TI	-13 EXTR [illegible] x 280 / -15 EXTR [illegible] x 280 / [illegible]	59.1 / 62.7 / 10.7	12.6 / 12.6 / 7.9
✓	BOND FIXS	840 REQ'D OF NAS 1933-C4-02	DRILL & PULL	AS		.5	.5
-65	[illegible]	SHEAR, CHEM-ETCH .03 DEEP, DRILL 570 HOLES	SEE NOTE AT LEFT	6AL-4V STA	[illegible]	18.7	9.20#
-811	[illegible] FWD PYLON FITTING	FAB NOTE: UPPER & LOWER FLANGES ARE ROUGH MACHINED FROM TI PLATE & EB WELDED TO EXTRUDED CENTER CYLINDER. WELDED ASSY IS THEN FINISH MACHINED.	SEE NOTE AT LEFT	6AL-4V ANN.	-19 UPR FLG 1.5x15x15 / -21 LWR FLG 1.75x15x15 / -23 CYL. 8.5 DIA x .25 WT x 9.5 long	54.0# / 63.2# / 53.3	(33.8#)
-813	OUTBD FWD PYLON FITTING		SAME FAB AS -811 ABOVE	6AL-4V ANN.	-25 UPR FLG 1.7?x15x14 / -27 LWR FLG 1.5x15x14 / -29 CYL 6.500 x .25 WT x 6.8	59.0# / 50.5 / 36.2	(2?.6#)
-815	INBD FIXED PYLON FITTING	• FORM UPR & LOWER DOUBLERS & MACHINE. • EB WELD PYLON ATTACH BOLT FITTING BLOCK TO LWR DOUBLER & MACHINE TO CONFIG PER SECT E-E • JOIN UPPER DOUBLER BY BORN THRU WELDING. JOIN WEBS BY EB WELD	SEE NOTE AT LEFT	6AL-4V ANN TI	-31 UPR DBLR .60x9.0x20 / -33 FIG BLK 2.0x1x9 / -35 DBLR .60x21x26 / -37 WEB .25x21x14.0	2.77 / 33.6 / 14.0# / 8.4#	(19.1#)
-817	OUTBD FIXED PYLON FITTING		SAME FAB AS -815 ABOVE	6AL-4V ANN TI	-39 UPR DBLR .40x5x10.0 / -41 FIG BLK 2.0x12x6.0 / -43 LWR DBLR [illegible] / -45 WEB [illegible]	1.3 / 23.# / 12.7 / (2 pcs) 1.4	(16.5#)
-47	FIX'D PYLON DOUBLER	SEE INBD. FIXED PYLON	MACHINE CONTOUR & PROFILE	6AL-4V STA TI	[illegible] SHEET	14.[illegible]	(8.7#)
-49	FIXD PYLON DOUBLER	SEE SECT F-F	SAME AS -47 ABOVE	6AL-4V STA TI	[illegible] 38	12.7	[illegible] 355.[illegible]
-51 INSTL	FLAP [illegible] DOUBLER [illegible]	FORM, PROFILE & TAPER EDGES AS SHOWN IN SECT G-G 5 PCS	SEE NOTE AT LEFT	6AL-4V STA TI	5 pcs- [illegible]	5 pcs = 6.3#	5.[illegible]
-53 INSTL	FLAP TO [illegible] LWR DOUBLER INSTL		SAME AS -51 FOR (5 PCS)	6AL-4V STA-TI	5 pcs - [illegible]	5 pcs = 9.0#	[illegible]
-55	WEB INSTL	PROFILE, FORM [illegible] ASSY	[illegible]	[illegible] ANN TI	[illegible]	[illegible]	[illegible]
-57	WEB [illegible]	[illegible] TO MATCH [illegible]	[illegible]	[illegible] 4V TI	[illegible]	1.3#	[illegible]
-59	[illegible]		[illegible]	6AL 4V	[illegible]	.9	[illegible]
-61	[illegible]	[illegible] ASSY	SEE NOTE AT LEFT	[illegible]	[illegible]	1.[illegible]	[illegible]
-63	[illegible]	[illegible] SECT	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
							#$84,163

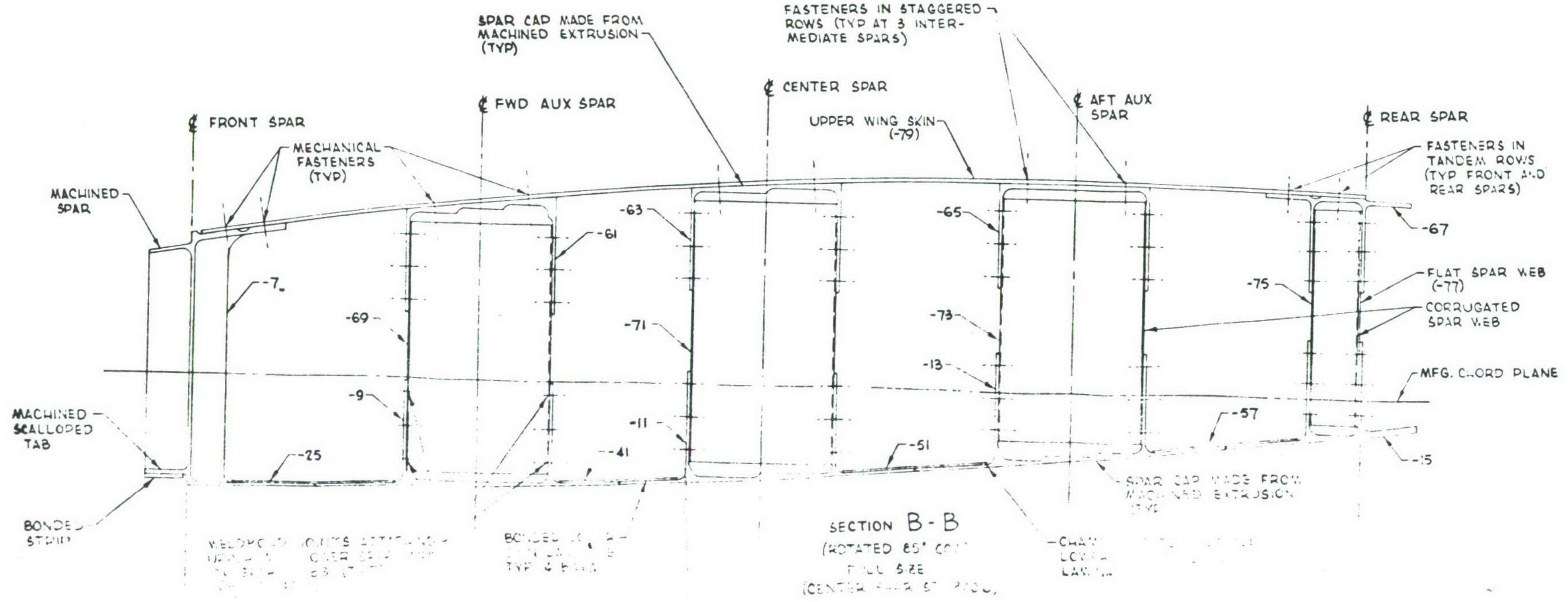
610RW002 Sheet 2



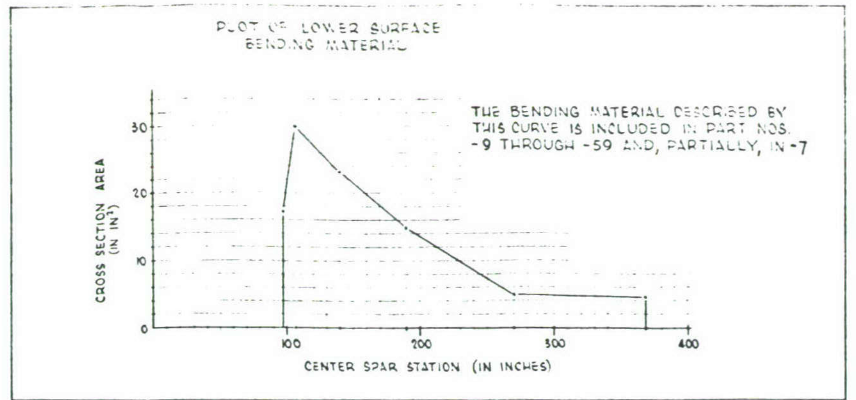
610RW003 Sheet 1



SECTION A-A
(ROTATED 90° CCW)
HALF SIZE
(CENTER SPAR STA 1400)

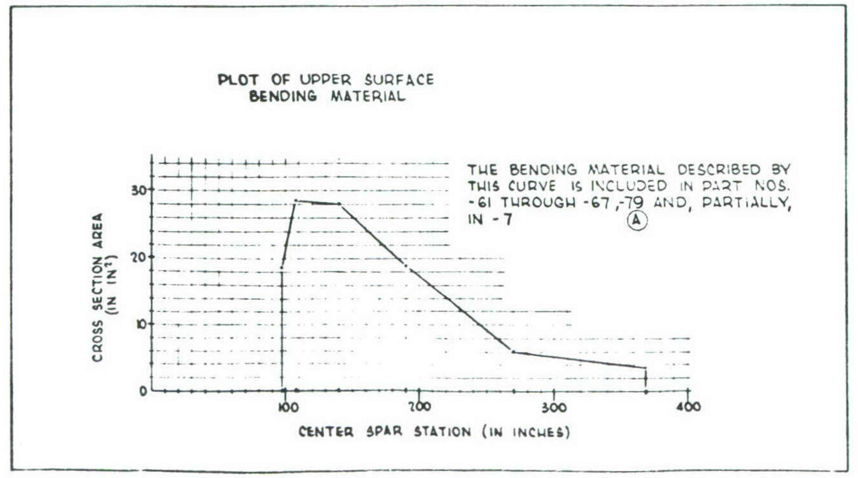


SECTION B-B
(ROTATED 85° CCW)
FULL SIZE



DASH NO.	PART NAME	NO. REQD	DESCRIPTION	MATERIAL	RAW STOCK SIZE	RAW MTL.WT.	FINISHED WEIGHT (LB)	COST ($)
-9	LWR FAS SPAR CAP	1	MACHINE FROM EXTRUSION	7050-T76511 AL. ALLOY	EXTRU × 278 (12.5 IN²)	347.5	184.3	
-11	LWR CS SPAR CAP	1			EXTRU × 278 (11.3 IN²)	314.1		
-13	LWR AAS SPAR CAP	1			EXTRU × 278 (10.2 IN²)	283.6		
-15	LWR RS SPAR CAP	1	MACHINE FROM EXTRUSION	7050-T76511 AL. ALLOY	EXTRU × 282 (9.4 IN²)	265.1		
FS - FAS BAY								
-17	LAMINATE	1	PROFILE, CHEM. ETCH A CONSTANT TAPER IN 20 PERCENT OF THE THE TOTAL AREA OF ALL OF THE LAMINATES, ROLL FORM CONTOUR PRIOR TO BONDING (A)	7050-T76 ALUMINUM ALLOY SHEET	.125 × 12.5 × 34	5.3	136.3	
-19		1			.125 × 12.5 × 60	9.4		
-21		1			.090 × 11.1 × 88	8.8		
-23		1			.090 × 9.7 × 136	11.8		
-25		1			.090 × 8.3 × 273	20.4		
-27		1			.090 × 6.9 × 177	11.0		
FAS - CS BAY								
-29	LAMINATE	1			.125 × 12.0 × 29	4.4		
-31		1			.080 × 12.0 × 36	3.5		
-33		1			.080 × 12.0 × 44	4.2		
-35		1			.080 × 12.0 × 81	7.8		
-37		1			.080 × 10.6 × 116	9.8		
-39		1			.080 × 9.1 × 151	11.0		
-41		1			.080 × 7.7 × 273	16.8		
-43		1			.090 × 6.2 × 177	9.9		
CS - AAS BAY								
-45	LAMINATE	1			.100 × 12.5 × 61	7.6		
-47		1			.090 × 11.0 × 91	9.0		
-49		1			.090 × 9.6 × 133	11.5		
-51		1			.090 × 8.1 × 273	19.9		
-53		1			.090 × 6.6 × 177	10.5		
AAS - RS BAY								
-55	LAMINATE	1			.070 × 11.9 × 118	9.8		
-57		1			.090 × 12.6 × 279	31.6		
-59		1			.090 × 11.3 × 184	18.7		
-7	FRONT SPAR	1	MACHINED, ONE-PIECE, INTEGRALLY STIFFENED MEMBER	7050-T73651 AL. ALLOY	5.0 × 9.5 × 268	1273.0	64.8*	

*24.4 LB. OF THIS WEIGHT IS INCLUDED IN THE LOWER SURFACE BENDING MATERIAL CURVE AND 16.8 LB. IS INCLUDED IN THE UPPER SURFACE BENDING MATERIAL CURVE



DASH NO.	PART NAME	NO. REQD	DESCRIPTION	MATERIAL	RAW STOCK SIZE	RAW MTL.WT.	FINISHED WEIGHT (LB)	COST ($)
-61	UPR FAS SPAR CAP	1	MACHINE FROM EXTRUSION	7050-T7651[illegible] AL. ALLOY	EXTRU × [illegible] (1.4 [illegible])	56.5	55.8	
-63	UPR CS SPAR CAP	1			EXTRU × 265 (1.3 IN²)	54.2		
-65	UPR AAS SPAR CAP	1			EXTRU × 263 (1.3 IN²)	54.2		
-67	UPR RS SPAR CAP	1	MACHINE FROM EXTRUSION	7050-T7651[illegible] AL. ALLOY	EXTRU × 277 (1.2 IN²)	52.4		
-79	UPR SURF SKIN	1	PROFILE, FORM, MACHINE AND CHEM. ETCH (UPR SIMILAR TO BASELINE WING UPPER SURFACE SKIN)	7050-T73651 AL. ALLOY	1.0 × 60 × 280	1660.0	332.7	
-69	FAS CORR. SPAR WEB	1	PROFILE, CHEM. ETCH AND FORM*	7050-T76 ALUMINUM ALLOY	.071 × 11.3 × 352	28.2	15.8	
-71	CS CORR. SPAR WEB	1	PROFILE, CHEM. ETCH AND FORM*		.071 × 13.5 × 352	33.7	18.4	
-73	AAS CORR. SPAR WEB	1	PROFILE, CHEM. ETCH AND FORM*		.063 × 12.5 × 352	27.7	11.5	
-75	RS CORR. SPAR WEB	1	PROFILE, CHEM. ETCH AND FORM**		.040 × 11.5 × 334	15.4	8.9	
-77	RS FLAT SPAR WEB	1	PROFILE (.040 CONSTANT)	7050-T76 ALUMINUM ALLOY	.040 × 11.5 × 271	12.4	7.8	

*LENGTH FACTOR FOR FORMING CORRUGATIONS IN -69, -71 AND -73 IS 1.32
**LENGTH FACTOR FOR FORMING CORRUGATIONS IN -75 IS 1.24

	FASTENERS (BLIND)	1488	FOR WEIGHT AND COST, ASSUME NAS1921 M08-08 FOR UPR. SURF. ATTACH	MONEL	-	-	17.6	
			FITTINGS, BULKHEADS, BUSHINGS, SEALANT AND GASKETS				355.0	
	ADHESIVE	AR	SEE NOTES 1 AND 2	AF 66 AF 143	195 FT²		19.5	
			ADDITIONAL MATERIAL REQUIRED TO ACCOMPLISH ROOT SPLICE	7050-T73651 AL. ALLOY			35.5	
						TOTALS	1261.4	$55377

NOTES:

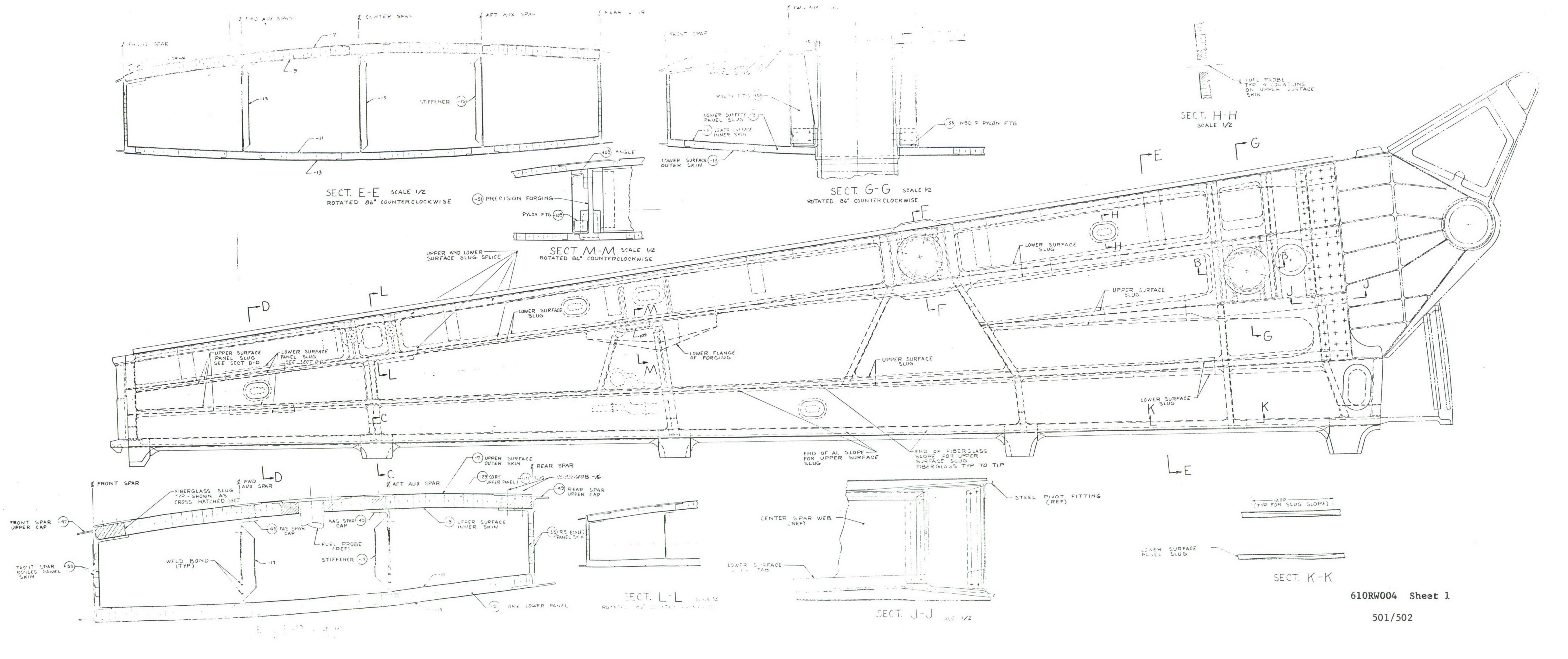
3. THE FAYING SURFACES FORMED BY THE -79 UPPER SURFACE SKIN AT THE FRONT AND REAR SPAR, AND ALL FASTENERS, SHALL BE SEALED IN ACCORDANCE WITH GENERAL DYNAMICS SPECIFICATION FPS-1004.
2. APPLY AF 143 ADHESIVE (3M COMPANY) BETWEEN ALL LOWER SURFACE SKIN LAMINATES, THE ADJACENT STEPPED LOWER FLANGE OF -7 FRONT SPAR, AND ADJACENT STEPPED FLANGES OF THE FOUR LOWER SPAR CAPS (-9 THRU -15).
1. THE CORRUGATED SPAR WEBS (-69 THRU -75) AND THE -77 FLAT REAR SPAR WEB ARE JOINED TO THE UPPER AND LOWER SPAR CAPS BY THE "WELD BOND" PROCESS WHICH COMBINES SPOTWELDING AND ADHESIVE BONDING. IN THIS PROCESS, APPLY AF66 ADHESIVE (3M COMPANY) IN THE FAYING SURFACES OF THE PARTS BEFORE SPOTWELDING. (DESIGN AND PROCESS CONTINGENT UPON TEST.)

PRELIMINARY DESIGN DRAWING

WING BOX - LAMINATED LWR. SKIN WITH STEPPED SPAR CAPS; PLATE UPPER SKIN; CORRUGATED SPAR WEBS [illegible]

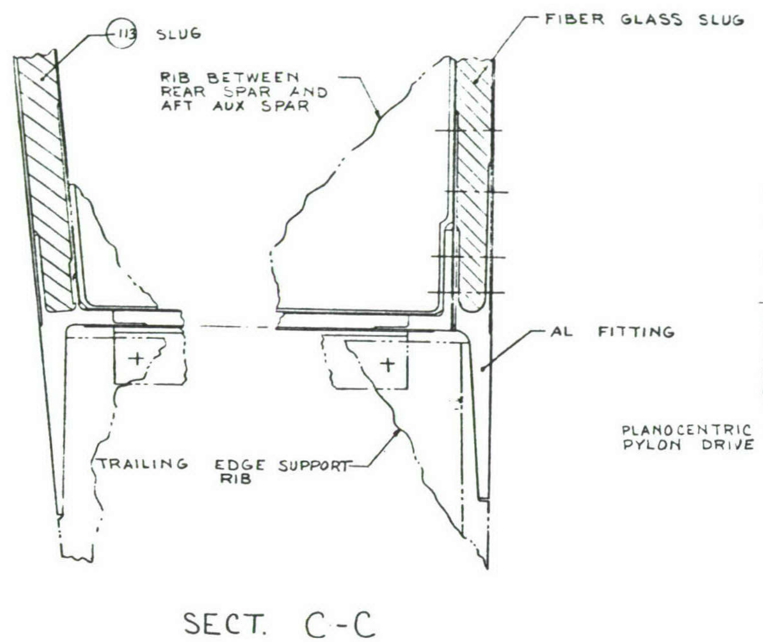
610RW003 A

610RW003 Sheet 2

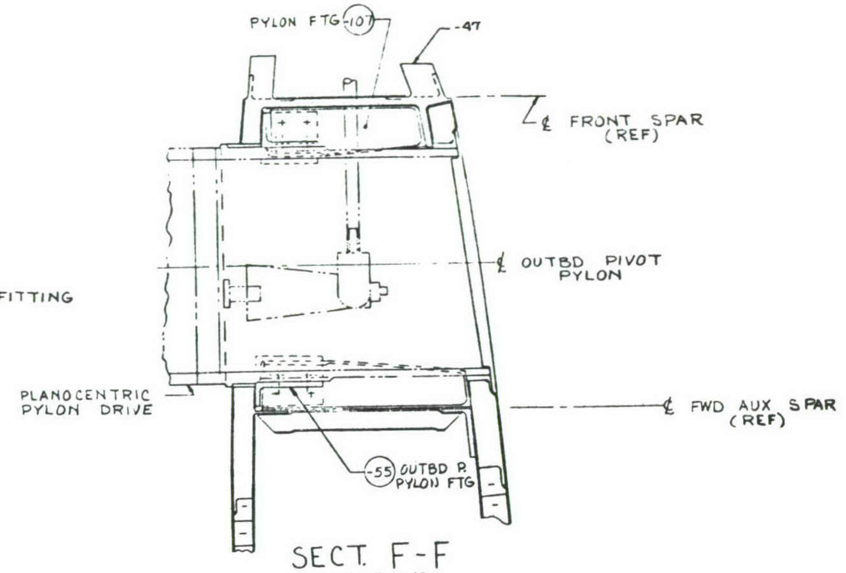


610RW004 Sheet 1

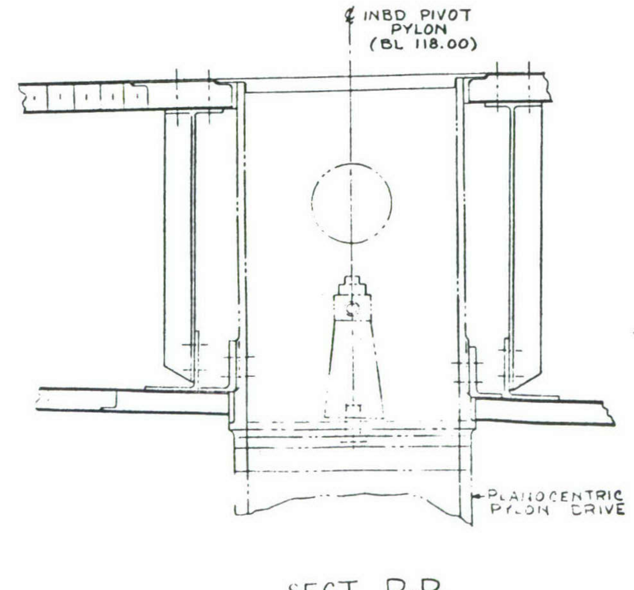
501/502



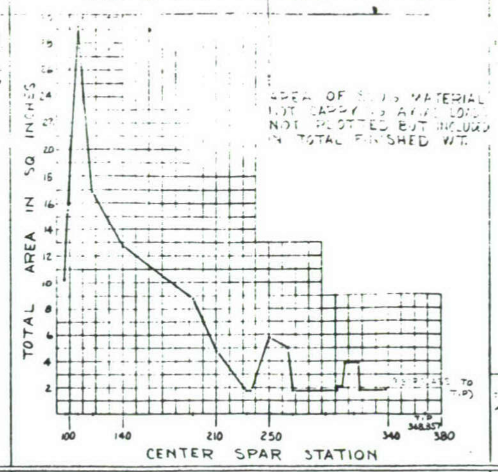
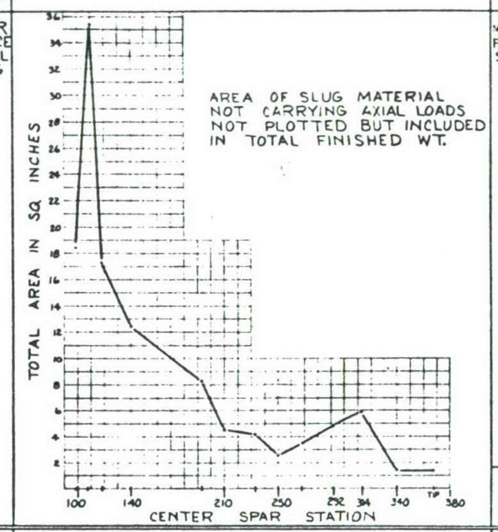
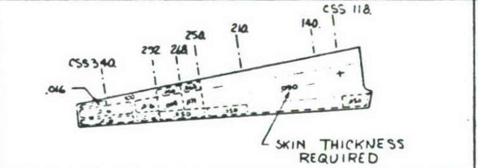
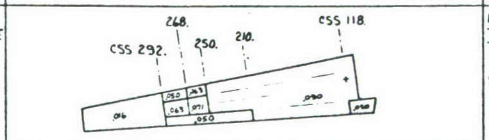
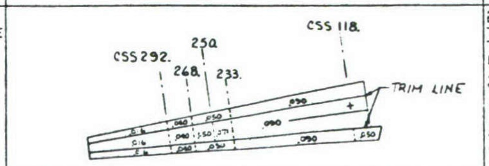
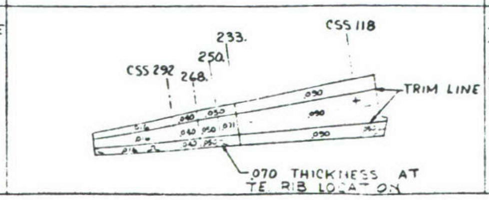
SECT. C-C
SCALE 1/1

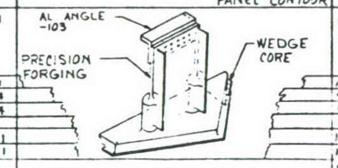


SECT. F-F
SCALE 1/2



SECT. B-B
SCALE 1/2

DASH NO.	PART NAME	PLOT OF AREA VS WING SPAN STA	REMARKS	MATERIAL	RAW STOCK SIZE & DESCRIPTION	RAW MATL. WEIGHT	FINISHED WEIGHT	COST
-1	UPPER SURFACE PANEL SLUG		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	
			-111 PRE-FORMED WET LAYUP	181 STYLE IMPREGNATED WITH FMS 1023 CLASS II RESIN	363 CU.IN.	—	24.00	
-3	LOWER SURFACE PANEL SLUG		MACHINE SLUG FROM PLATE STOCK	AL 7050 -T73651	INBD SECT PLATE 2.25X65.5X74; INBD FIX PYL PL 2.10X13.5X74; OUTBD FIX PYL PL 2.10X12.0X53.5; FRONT SPAR SLUG 2.10X3.5X104, 2.10X3.5X54, 2.10X2.5X48; FWD AUX SPAR SLUG 2.10X5.5X52, 2.10X3.3X102, 2.10X2.0X48; CENTER SPAR SLUG 2.10X5.8X46; AFT AUX SPAR SLUG 2.10X3.8X241; REAR SPAR SLUG 2.10X7.2X249; TIP SLUG 2.10X2.0X12	2,699.98	220. BENDING AXIAL; 19. NON AXIAL; INCLUDED IN 355 WT.	
			-113 PRE-FORMED WET LAYUP	181 STYLE IMPREGNATED WITH FMS 1023 CLASS II RESIN	42 CU. IN		2.73	
-7	UPPER SURFACE OUTER SKIN		ETCH SKIN TO .016 MIN THICKNESS FROM .100 AL SHEET STOCK	AL 7050 -T76	.100X100X300 ½ OF THIS MATL TO BE USED FOR SKIN BELOW	153	88.50	
-9	UPPER SURFACE INNER SKIN		ETCH SKIN TO .016 MIN. THICKNESS FROM .090 AL SHEET STOCK	AL 7050 -T76	USE MATL FROM SHEET ABOVE	153	76.00	
-11	LOWER SURFACE INNER SKIN		ETCH SKIN TO .016 MIN. THICKNESS FROM .090 AL SHEET STOCK. CUT INTO 3 PIECES AFTER ETCHING	AL 7050 -T76	.090X[illegible]X[illegible] ½ OF THIS MATL TO BE USED FOR SKIN BELOW	137.7	80.50	
-13	LOWER SURFACE OUTER SKIN		ETCH SKIN TO .016 MIN THICKNESS FROM .090 AL SHEET STOCK. CUT INTO 3 PIECES AFTER ETCHING	AL 7050 -T76	USE MATL FROM SHEET ABOVE	137.7	80.50	

DASH NO.	PART NAME	QTY	SKETCHES AND/OR INFORMATION	REMARKS	MATERIAL	RAW STOCK SIZE & DESCRIPTION	RAW MATL WEIGHT	FINISHED WEIGHT	COST
-15	[illegible]	43	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	
-17	STIFFENER	36	[illegible]	[illegible]	AL 7050 -T76511 EXTR	[illegible]	(TOTAL)	[illegible]	
-19	WEB	1	LOCATION: INBD SECT FOR FAS	[illegible]	AL 7050 -T76	[illegible]	13.10	10.[illegible]	
-21		1	INBD SECT FOR [illegible]			[illegible]	5.90	5.42	
-23		1	INBD SECT FOR AAS			[illegible]	13.00	[illegible]	
-25		1	OUTBD SECT FOR FAS			[illegible]	2.72	[illegible]	
-27	WEB	1	OUTBD SECT FOR AAS			[illegible]	2.59	[illegible]	
-29	CORE UPPER PANEL	1		TRIM TO FIT BETWEEN SLUGS	P006-1B	[illegible]	17.40	15.20	
-31	CORE LOWER PANEL	1		TRIM TO FIT BETWEEN SLUGS	P006-1B	7,900 [illegible]	15.40	14.00	
-33	FS BONDED PANEL SKIN	2	MAKE BOTH SKINS FROM ONE PIECE FROM SIZE NOTED	ETCH TO A MIN. THICKNESS OF .016, 103.00 FROM TIP	AL 7050 -T76	.240X11.5X270	11.80 (TOTAL)	9.04 (TOTAL)	
-35	RS BONDED PANEL SKIN	2	MAKE BOTH SKINS FROM ONE PIECE FROM SIZE NOTED	ETCH TO A MIN. THICKNESS OF .016, 103.00 FROM TIP	AL 7050 -T76	.020X11.5X270	6.20 (TOTAL)	5.62 (TOTAL)	
-37	FS BONDED PANEL CORE	1	MAKE FS & RS CORE FROM ONE PIECE FROM SIZE NOTED	CUT & MAKE RECESS AT ENDS	P006-1C	2.7X10.X265 FOR FS & RS	2.16 (TOTAL)	1.00	
-39	RS BONDED PANEL CORE	1	SEE ABOVE	CUT & MAKE RECESS AT ENDS	P006-1C	SEE ABOVE	SEE ABOVE	1.16	
-41	CS SPAR CAP	1	3.00 AT INBD END; 1.00 AT OUTBD END; .17; 1.07; MACHINE AS REQD TO MATCH CONTOUR; .06	TRIM WIDTH OF CAP TO SHAPE AS SHOWN ON PLAN VIEW	AL 7050 -T736511 EXTR.	.55 SQ IN X 75.	4.15	3.30	
-43	AAS SPAR CAP	1	2.50 AT INBD END; 1.00 AT OUTBD END; .20; 1.10; MACHINE AS REQD TO MATCH CONTOUR; .06	TRIM WIDTH OF CAP TO SHAPE AS SHOWN ON PLAN VIEW	AL 7050 -T736511 EXTR.	.55 SQ IN. X 265.0	14.50	11.40	
-45	FAS SPAR CAP	1	SEE ABOVE	SEE ABOVE	SEE ABOVE	SEE ABOVE	14.50	11.40	
-47	FRONT SPAR UPPER CAP	1	THICKNESS AS SHOWN REQD ONLY LOCAL; 2.40; MACHINE AS REQD TO MATCH PANEL CONTOUR; .45; 1.55; 2.10; MACHINE FROM EXTR.; .050; .270; 1.25	MACHINE SURFACES TO MAINTAIN PROPER CONTOUR AND TRIM TO LENGTH.	AL 7050 -T736511 EXTR.	2.85 SQ IN. X 265.0	75.00	19.30	
-49	REAR SPAR UPPER CAP	1	1.95; 1.00; .20; .30; .15; 2.40; .050; .270; MACHINE AS REQD TO MATCH PANEL CONTOUR	SEE ABOVE	SEE ABOVE	11.27 SQ.IN X 265.0	30.00	16.80	
-51	FIXED PYLON (INBD) FITTING	1	 AL ANGLE -103; PRECISION FORGING; WEDGE CORE	PRECISION FORGING	AL 7050 -T 736	—	40.0	(29.1	
-109	PYLON FTG	1		MACHINE PART	[illegible]	[illegible]X13X52	.75		
-107	PYLON FTG	4		MACHINE PART	[illegible]	1.5X13X[illegible]	1.27 EA		
-105	PYLON FTG	4		MACHINE PART	[illegible]	[illegible]	3.22 EA		
-103	ANGLE			ANGLE (EXTR)	[illegible]	[illegible]	.10		
-53	INBD R PYLON FTG	1		MACHINE PART	[illegible]	[illegible]X12X14	44.5		
-55	OUTBD R PYLON FTG	1		MACHINE PART		[illegible]X12X1[illegible]	38.1		
-57	BHD MATL	1		MACHINE PARTS		2.25X25X4[illegible]	33.7		
-59		1				2.25X13.5X[illegible]	32.5		
-61		1				2.25X11.2X14[illegible]	32.8		
-63		1				2.25X[illegible]X37	35.2		
-65		3				1.50X11.5X14.0	24.5 EA		
-67		1				2.50X11X[illegible]	36.5	355.[illegible]	
-69		1				1.50X8.0X12.[illegible]	15.3		
-71		1				1.50X9.0X26.5	[illegible]		
-73		1				1.50X8.0X25.[illegible]	34.4		
-75		2				2.25X8.0X[illegible]	[illegible] EA		
-77		1				2.25X7.0X[illegible]	16.1		
-79		1				2.25X8.0X14.0	25.7		
-81		1			AL 7050 -T7365[illegible]	[illegible]	[illegible]		
-83	BHD MATL	2			AL 7050 -T7365[illegible]	[illegible]X7.0X25	35 EA		
-85	[illegible]	2			AL 7050 -T7365[illegible]	[illegible]	12.5 EA		
-87	BHD MATL	1				[illegible]	[illegible]		
-89		1				[illegible]	[illegible]		
-91	BHD MATL	1			AL 7050 -T7365[illegible]	[illegible]	37.9		
-93	TRAILING	1			AL 7050 -T7365[illegible]	[illegible]	13.5		
-95	EDGE	1				[illegible]X7.0X[illegible]	71		
-97	SLUG MATL	2				.25X7.0X9.0	43 EA		
-99		1				[illegible]X9.0	34		
-101	ADHESIVE	AR			AF143 (3M)	3.5 SQ.FT	—	31.50	
	FASTENERS, BLIND	1940	FOR PRICE AND WEIGHT ASSUME HAS-921MCB-16 FOR ALL UPPER SURF FAST.		MONEL		—	36.90	

GRAND TOTAL 1,351.15 #

$54,211

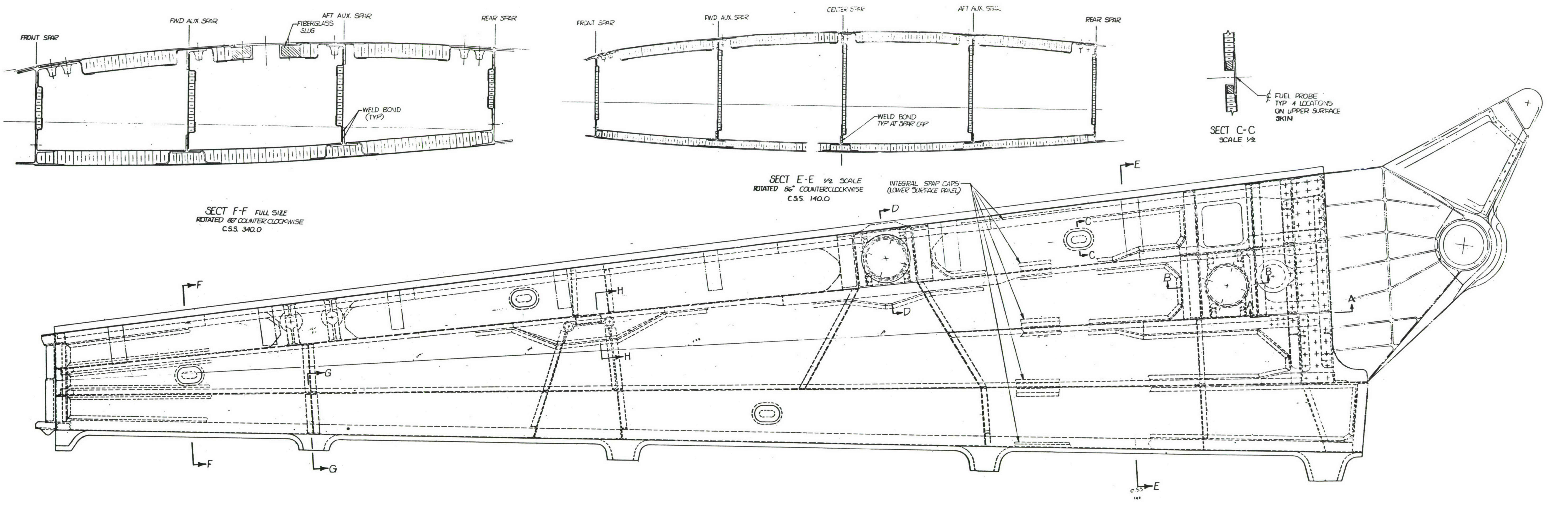
PRELIMINARY DESIGN DRAWING

WING BOX - ADHESIVE BONDED HONEYCOMB PANEL, UPPER AND LOWER

GENERAL DYNAMICS Convair [illegible]

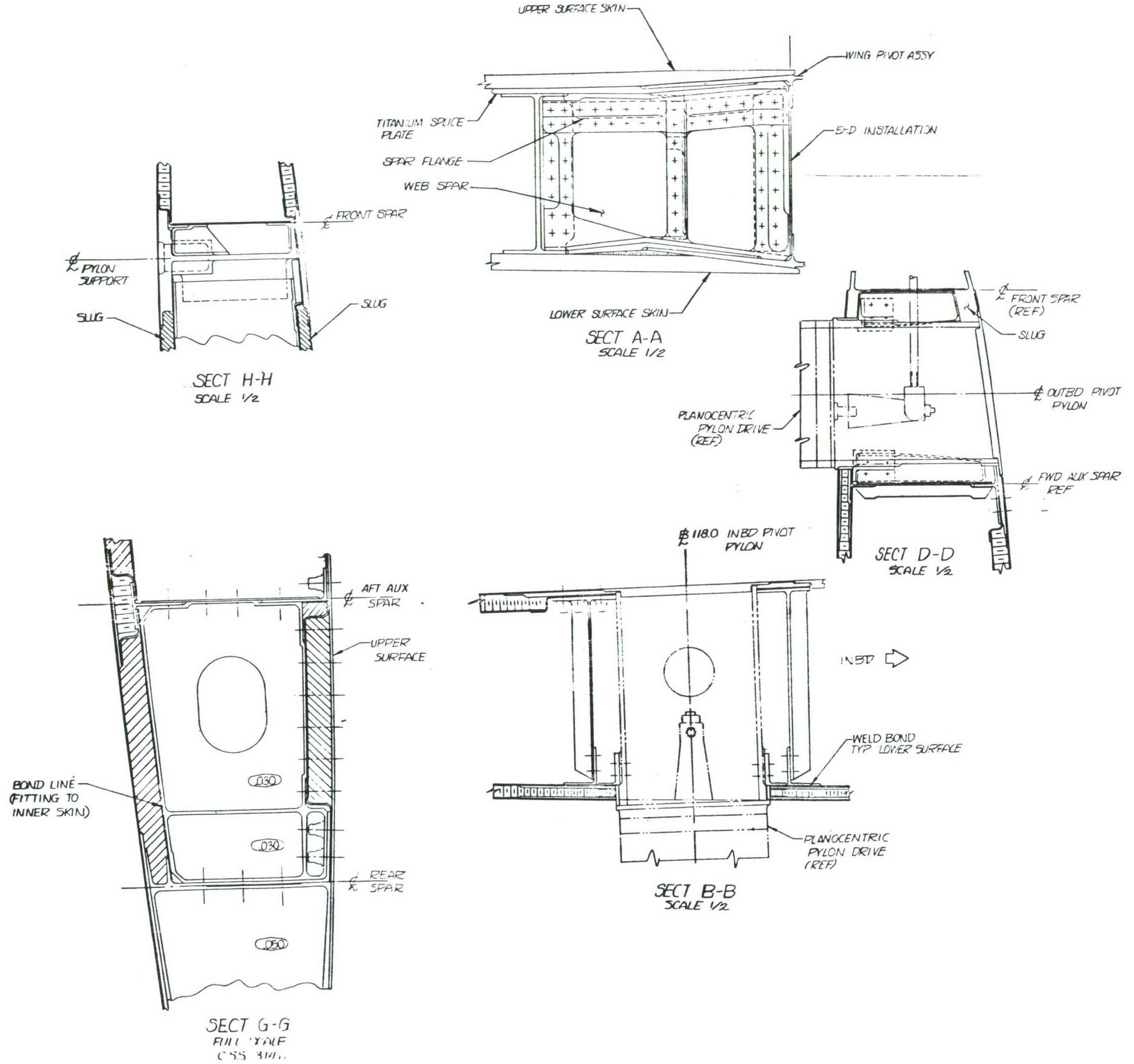
610RW004

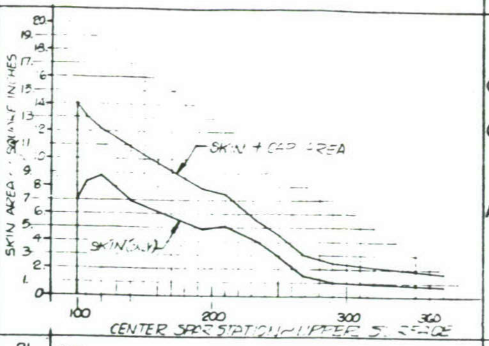
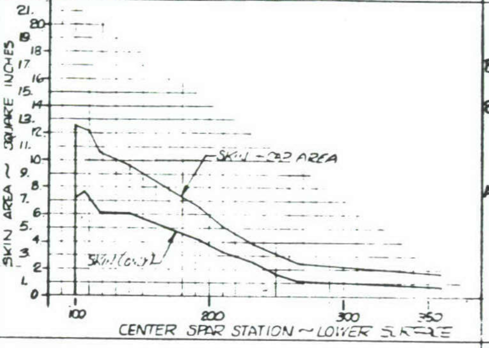
610RW004 Sheet 2



610RW005 Sheet 1

505/506



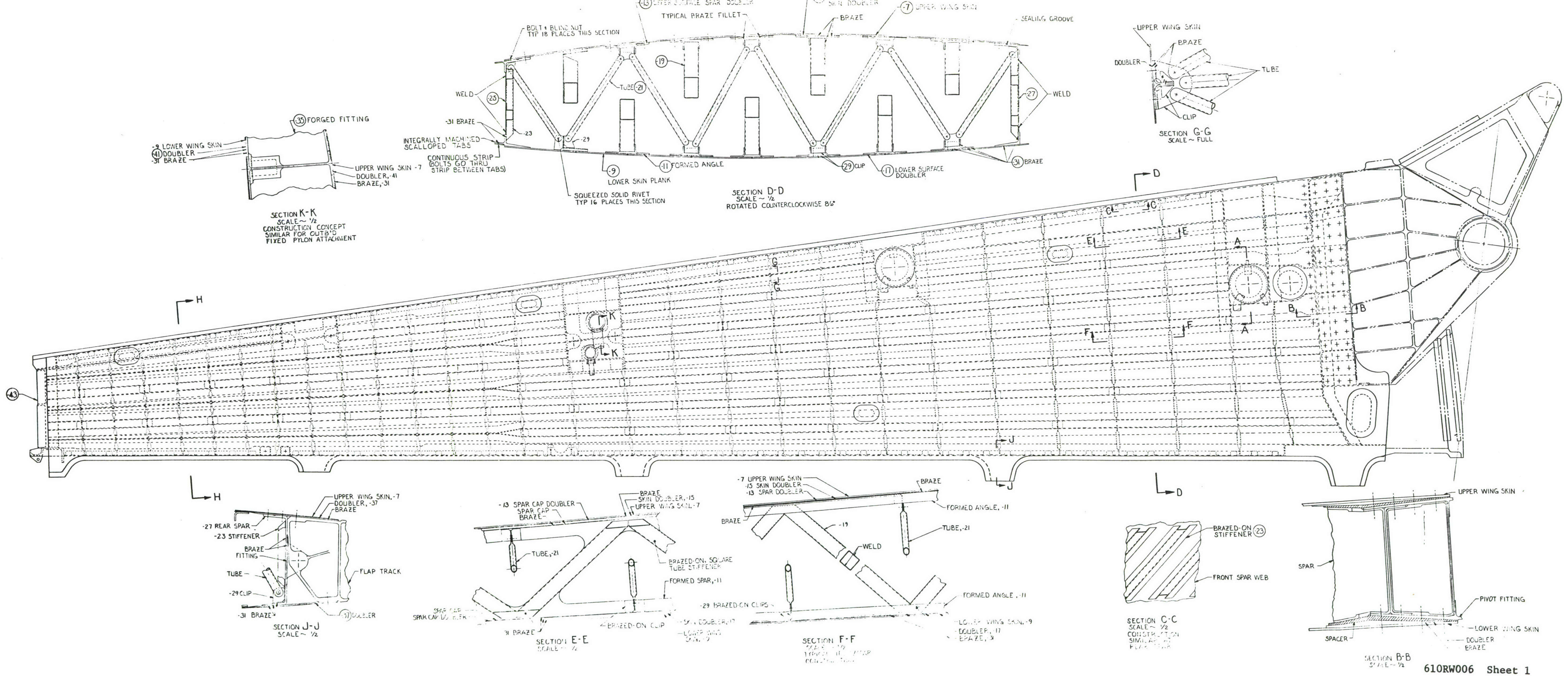
PART NAME	PLOT OF AREA VS WING SPAN STATION	MATERIAL	FINISHED WEIGHT
SKINS (2)		6-4 Ti STA	166.4
CAPS (5)		6-4 Ti STA	101.6
CORE		AL	33.8
ADHESIVE		AF 143(3M C®)	15.0
UPPER PANEL			316.8
SKINS (2)		8823 Ti STA	142.2
CAPS (5)		8823 Ti STA	102.8
CORE		AL	28.1
ADHESIVE		AF 143(3M C®)	15.0
LOWER PANEL			288.1
SKINS (10) DOUBLERS CORE ADHESIVE		8823 Ti STA 8823 Ti STA AL AF 143(3M C®)	85.3 65.2 12.1 16.1
SPAR WEB PANELS (5)			178.7
FASTENERS			40.0
SEALANT, PYLON ATTACH FITTINGS & BUILD-UPS, FLAP TRACK ATTACH BUILD-UPS TIP BULKHEAD			355.0
			1178.6

610RW005 Sheet 2

PRELIMINARY DESIGN DRAWING

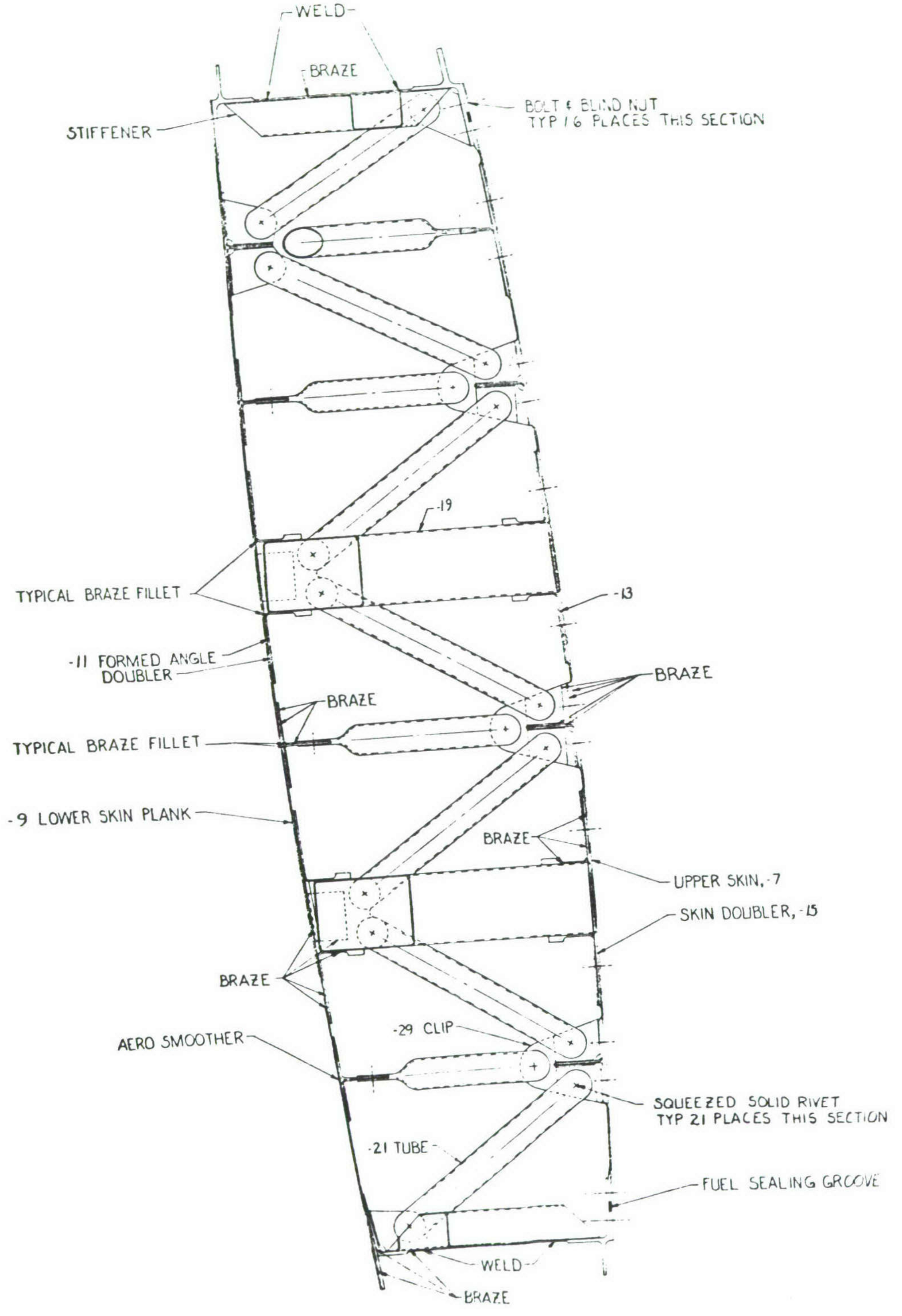
WING BOX - TITANIUM ADHESIVE BONDED HONEYCOMB PANEL, UPPER & LOWER

GENERAL DYNAMICS
Convair Aerospace Division



610RW006 Sheet 1

509/510

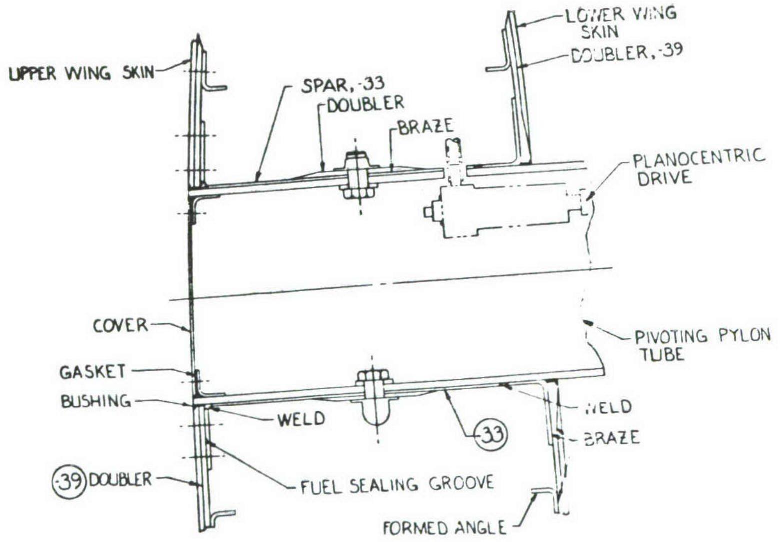


SECTION H-H

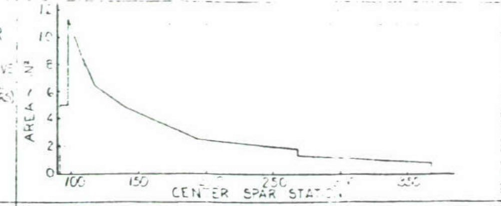
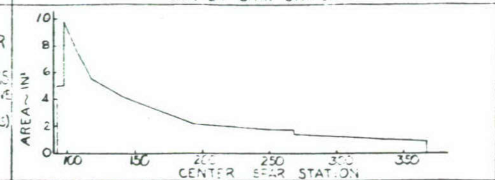
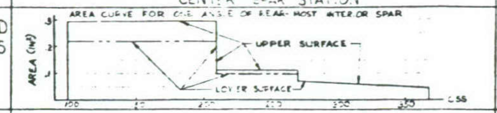
NOTES:

1. THE EXISTING F-111 LEADING EDGE SLAT DRIVE SYSTEM (i.e. TRACK-HOUSING "CANS" PROTRUDING INTO THE WING BOX) IS NOT COMPATIBLE WITH THIS DESIGN DUE TO THE NATURE OF THE SPACE-TRUSS UNDERSTRUCTURE. IT IS THEREFORE ASSUMED THAT A "POWER-HINGE" SYSTEM WILL BE EMPLOYED FOR THE SLAT DRIVE.

2. ALTERNATE UPPER-SURFACE-SKIN DESIGN CONCEPT: APPLY CHEM-ETCHING PROCESS TO INTEGRALLY FORM THE -15, -37, -39, & -41 DOUBLERS WITH THE -7 SKIN.

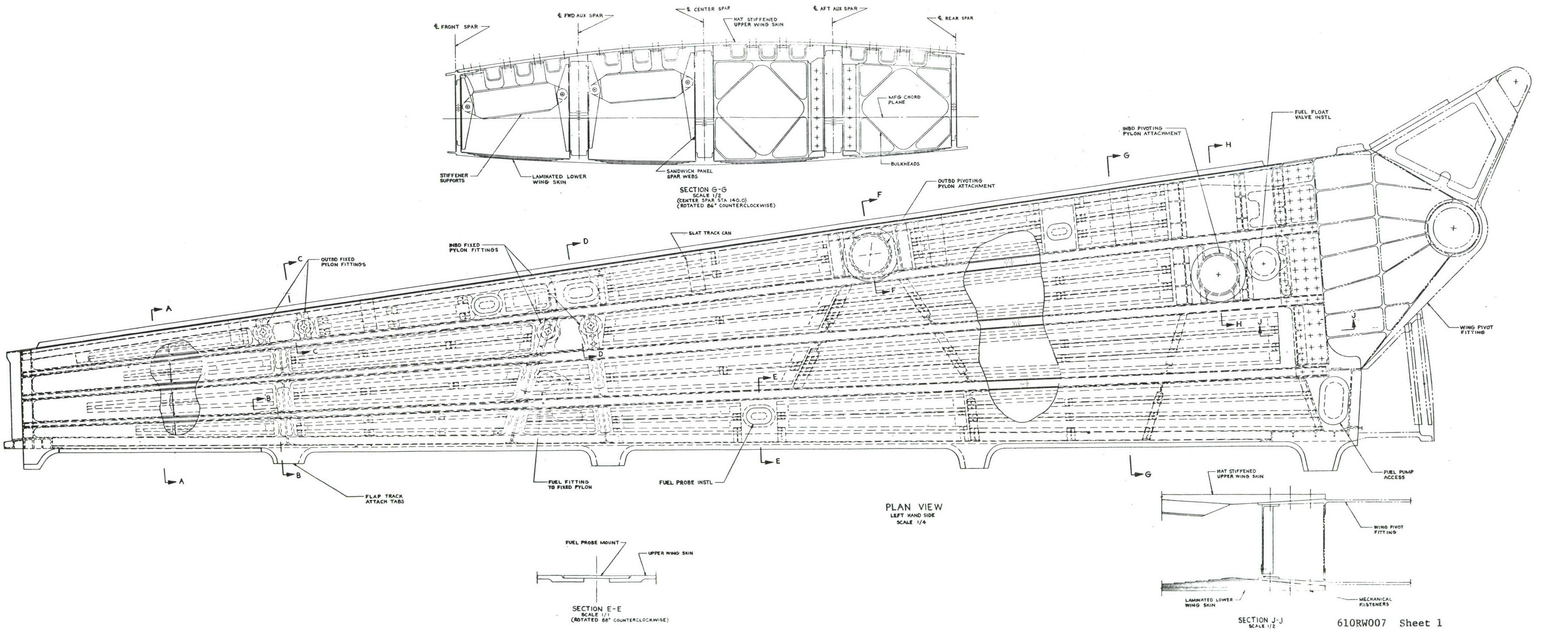


SECTION A-A
SCALE ~ 1/2
CONSTRUCTION CONCEPT
SIMILAR FOR OUTBD
PIVOTING PYLON ATTACHMENT

DASH NO.	PART NAME		[illegible]	MAT'L	[illegible]	[illegible]	[illegible]
-7	UPPER SKIN (EXCLUSIVE OF ALL DOUBLERS)		PROFILE, FORM & CHEM. ETCH. APPROX 180 IN OF VARIABLE TAPER, 50 IN OF CONST THICK. & 120 IN OF CONST. THICK.	6-4 Ti STA	t=.30	380* PER SKIN	128.51*
-9	LOWER SKIN PLANKS (EXCLUSIVE OF ALL DOUBLERS)		PROFILE, FORM & ETCH AS EXPLAINED ABOVE.	8-8-2-3 Ti STA	t=.160	343* PER SKIN	121.04
-11	FORMED ANGLES		PROFILE, FORM & CHEM. ETCH.	8-8-2-3 Ti STA	1 PC .125×36×280 1 PC .090×30×230 1 PC .032×25×65	377*	162.51*
-13	UPPER SURFACE SPAR DOUBLER		PROFILE & FORM	6-4 Ti STA	1 PC .250×3×65 1 PC .016×20×170 1 PC .016×10×250	24#	13.27*
-15	UPPER SURFACE SKIN DOUBLER		PROFILE, FORM & CHEM. ETCH	6-4 Ti STA	1 PC EACH .040×5×55 .050×50×110 .050×8×65 .090×24×30	133*	43.25*
-17	LOWER SURFACE DOUBLER		PROFILE, FORM & CHEM. ETCH	8-8-2-3 Ti STA	1 PC EACH .050×15×30 .063×4×26 .032×25×10 .250×2.5×24	99*	39.99*
-19	SQUARE TUBE		PROFILE, FORM & WELD	6-4 Ti STA	.032×8×100 .020×3×700	46*	41.93*
-21	ROUND TUBE		EXTRUDE, TRIM TO LENGTH, SWAGE ENDS	6-4 Ti ANNEALED	.625 O.D. .025 t 2400 LENGTH	19*	13.68*
-23	STIFFENER		PROFILE & FORM	6-4 Ti ANNEALED	.020×25×133	12*	10.32*
-25	FRONT SPAR		CAPS~MACHINED EXTRUSIONS WEB~CHEM. ETCHED SHEET	6-4 Ti STA	(2) .8 in²×280 .040×10×280	72* 16*	41.46*
-27	REAR SPAR		CAPS~MACHINED EXTRUSIONS WEB~CHEM. ETCHED SHEET	6-4 Ti STA	(2) .8 in²×280 .040×12×280	72* 22*	42.73*
-29	CLIP		PROFILE & FORM	8-8-2-3 Ti STA	.040×3×125	31*	23.42*
-31	BRAZING COMPOUND						34.43*
	FASTENERS	300 MS20615-5M RIVETS; 702 NAS1154V4 BOLTS; 867 NAS1153V3 BOLTS; 1270 NAS1152V2 BOLTS; 702 C520-428-2 NUTS; 867 C520-1032-1 NUTS; 1270 C520-832-1 NUTS					19.81*
-33	PIVOTING PYLON FITTINGS	LOWER CAPS ARE MACHINED EXTRUSIONS; UPPER CAPS & WEBS ARE SHEETS. BURN-THRU-WELD FABRICATION AFTER FORMING TO CONTOUR. FINAL MACHINED CLEANUP.	SEE NOTE AT LEFT	6-4 Ti STA	.8 in²×108 .250×30×40	71.45*	57.00* (*)
-35	FIXED PYLON FITTINGS	MACHINED CHANNEL FORGINGS WITH INTEGRAL TAPPED BOSSES WELDED TO MACHINED I FORGING MIDDLE SECTION. SUPPLEMENTARY CHANNEL MEMBERS FABRICATED IN SAME MANNER AS -33 PARTS.	SEE NOTE AT LEFT	6-4 Ti STA	.8 in²×24 (4)2.5×9×20 (4)2.5×9×6 .250×7×24	245*	44.50* (*)
-37	FLAP TRACK DOUBLERS	UPPER SURFACE~6-4 Ti STA; LOWER SURFACE~8-8-2-3 Ti STA	PROFILE & FORM	SEE NOTE AT LEFT	.090×22×25	10*	7.65* (*)
-39	PIVOTING PYLON DOUBLERS	UPPER SURFACE~6-4 Ti STA; LOWER SURFACE~8-8-2-3 Ti STA	PROFILE & FORM CHEM. ETCH	SEE NOTE AT LEFT	.250×20×40 .312×20×40	72*	54.00* (*)
-41	FIXED PYLON DOUBLERS	UPPER SURFACE~6-4 Ti STA; LOWER SURFACE~8-8-2-3 Ti STA	PROFILE & FORM CHEM. ETCH	SEE NOTE AT LEFT	.050×40×40 .125×40×28	35*	23.45* (*)
-43	TIP BULKHEAD		INVESTMENT CASTING~ USE AS CAST	6-4 Ti ANNEALED	22×4×6	1.8*	4.50* (*)
		SEALANT, GASKETS, BUSHINGS, PLUS ALL (*) ITEMS					355.00*
					TOTALS→	1109*	$122,120

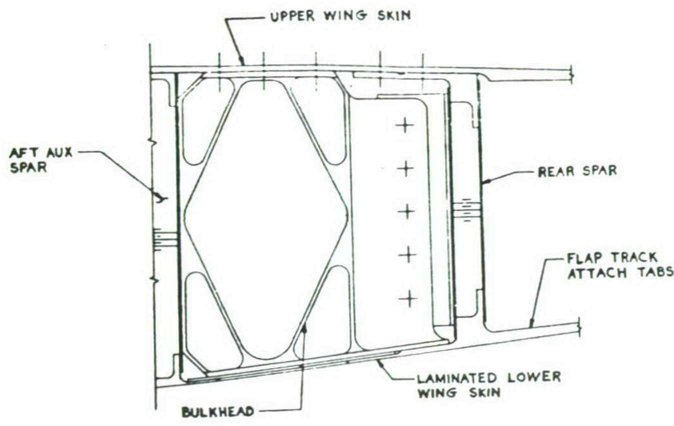
PRELIMINARY DESIGN DRAWING
WING BOX~BRAZED TITANIUM
SPACE-TRUSS STRUCTURE
GENERAL
Convair Aerospace

610RW006 Sheet 2

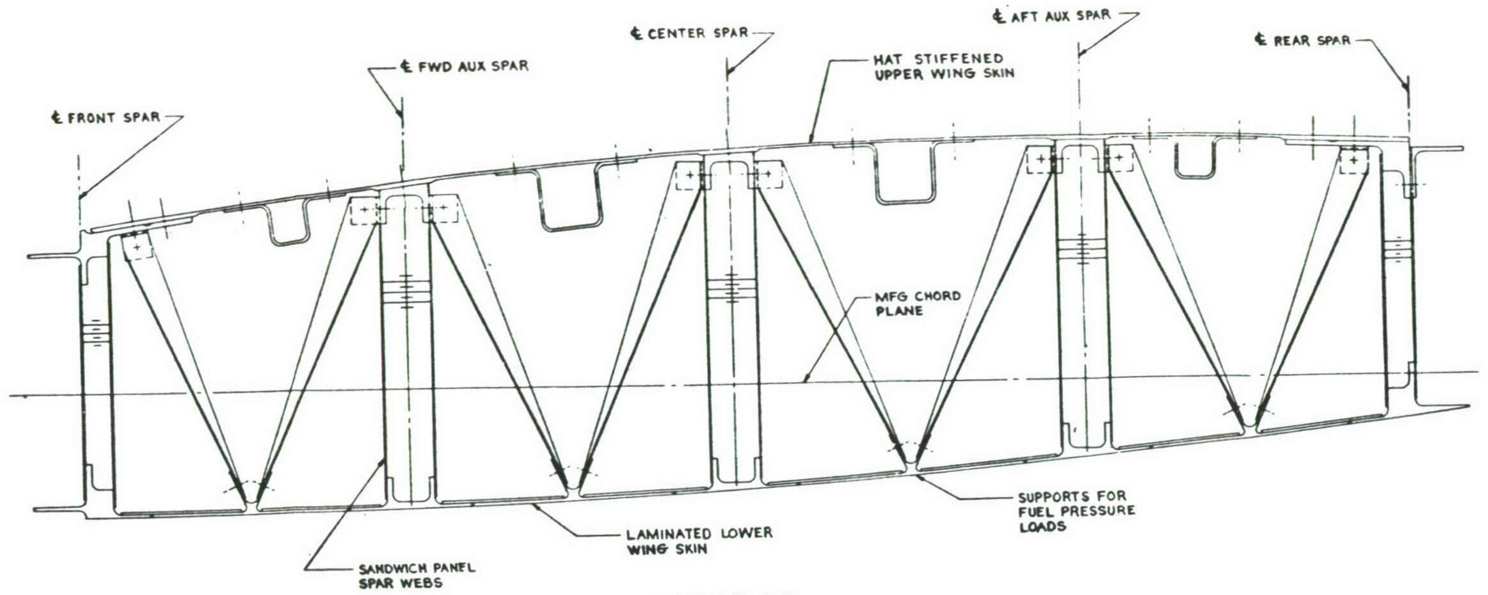


610RW007 Sheet 1

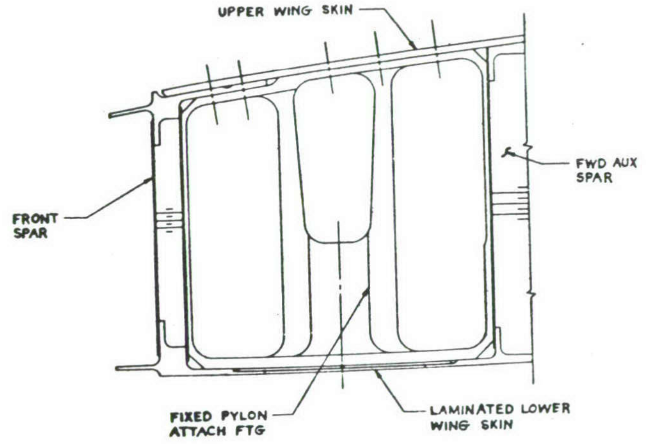
513/514



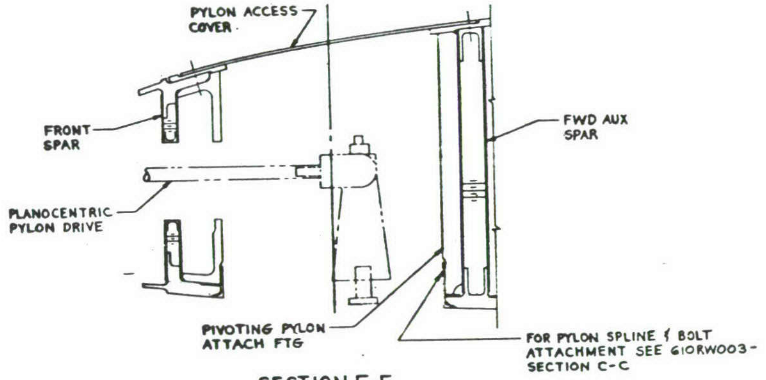
SECTION B-B
SCALE 1/1
(ROTATED 86° COUNTERCLOCKWISE)



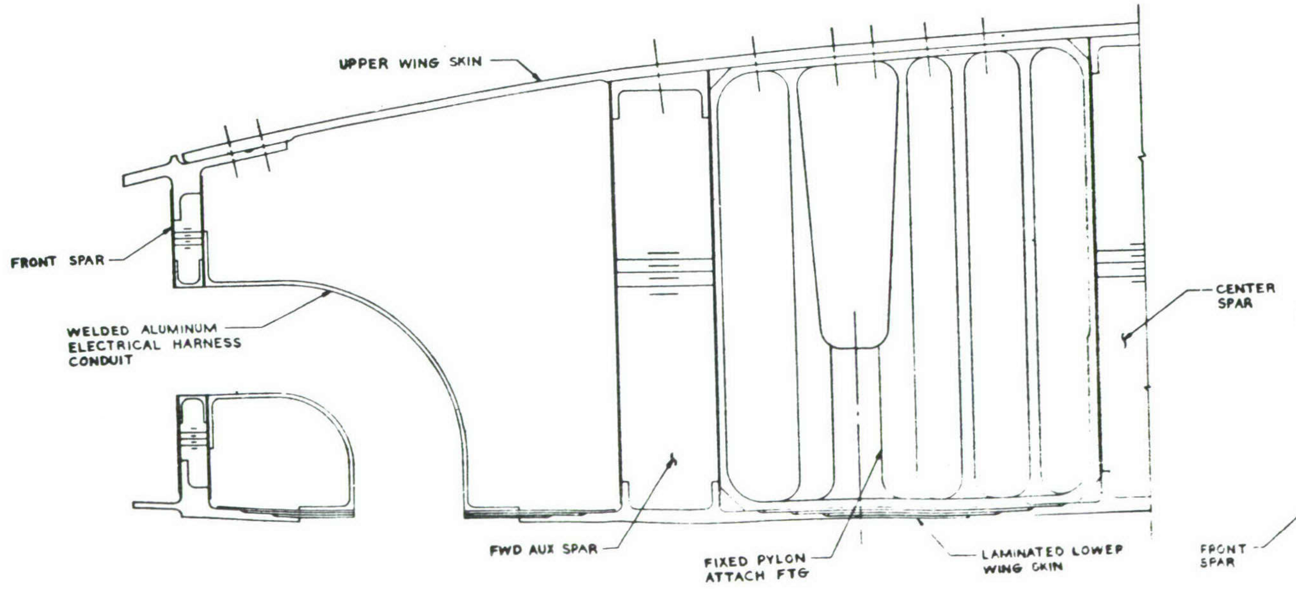
SECTION A-A
SCALE 1/1
(CENTER SPAR STA 340.0)
(ROTATED 86° COUNTERCLOCKWISE)



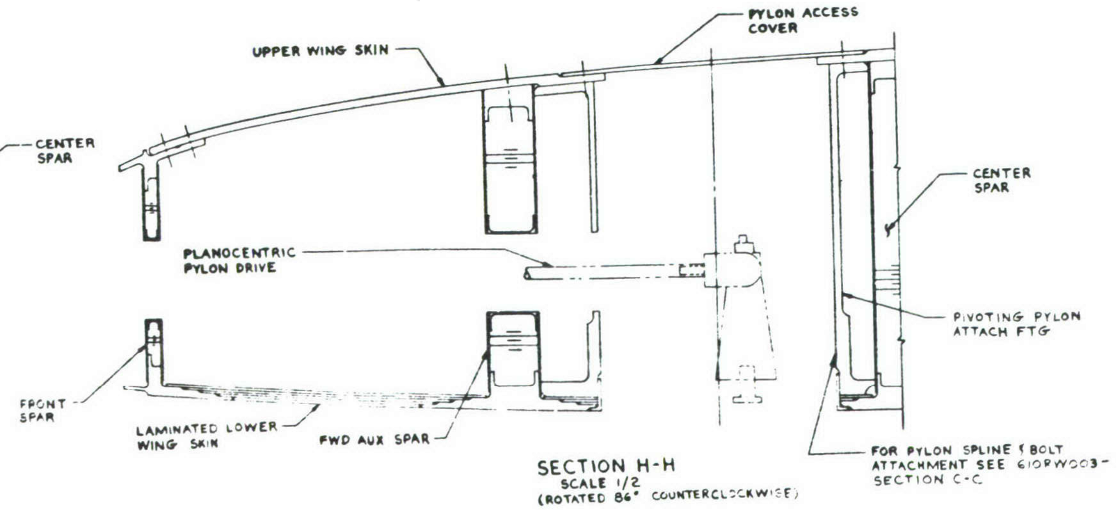
SECTION C-C
SCALE 1/1
(ROTATED 82° COUNTERCLOCKWISE)



SECTION F-F
SCALE 1/2
(ROTATED 82° COUNTERCLOCKWISE)



SECTION D-D
SCALE 1/1
(ROTATED 82° COUNTERCLOCKWISE)



SECTION H-H
SCALE 1/2
(ROTATED 86° COUNTERCLOCKWISE)

PART NAME	MATERIAL	FINISHED WEIGHT
HAT STIFFENED UPPER WING SKIN & SPAR CAPS	7050-T76 AL SKIN 7050-T76511 AL MACH. EXT. CAPS	417.3#
LAMINATED LOWER WING SKIN & SPAR CAPS	7050-T76 AL SKIN 7050-T76511 AL MACH. EXT. CAPS	347.4#
FRONT SPAR WEB & CORE	7050-T76 AL 4.5#/FT³ AL CORE	10.3#
FWD AUX SPAR WEB & CORE	↑	19.1#
CENTER SPAR WEB & CORE		20.7#
AFT AUX SPAR WEB & CORE	↓	19.8#
REAR SPAR WEB & CORE	7050-T76 AL 4.5#/FT³ AL CORE	11.5#
PRESSURE SUPPORTS	7050-T76 AL	1.2#
HAT SECTION SUPPORTS	7050-T76 AL	31.2#
SEALANT, PYLON ATTACH FITTINGS & BUILD-UPS, FLAP TRACK ATTACH BUILD-UPS, & BULKHEADS		355.0#
ADHESIVE	AF143	69.6#
FASTENERS & PRESSNUTS		43.6#

TOTAL WT = 1347#

PRELIMINARY DESIGN DRAWING

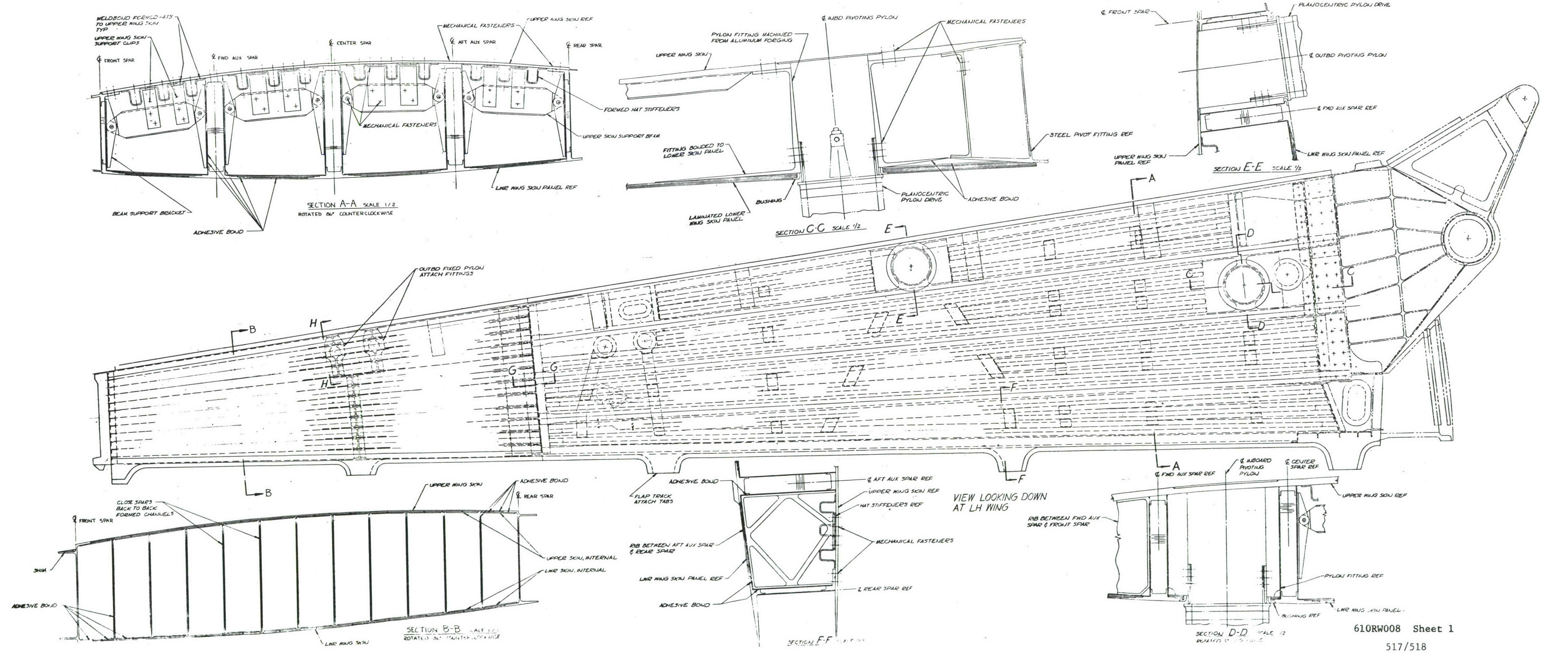
WING BOX-LAMINATED LWR SKIN WITH STEPPED SPAR CAPS; HAT STIFFENED UPR SKIN; SANDWICH PANEL SPARS; ALUMINUM

4-26-73

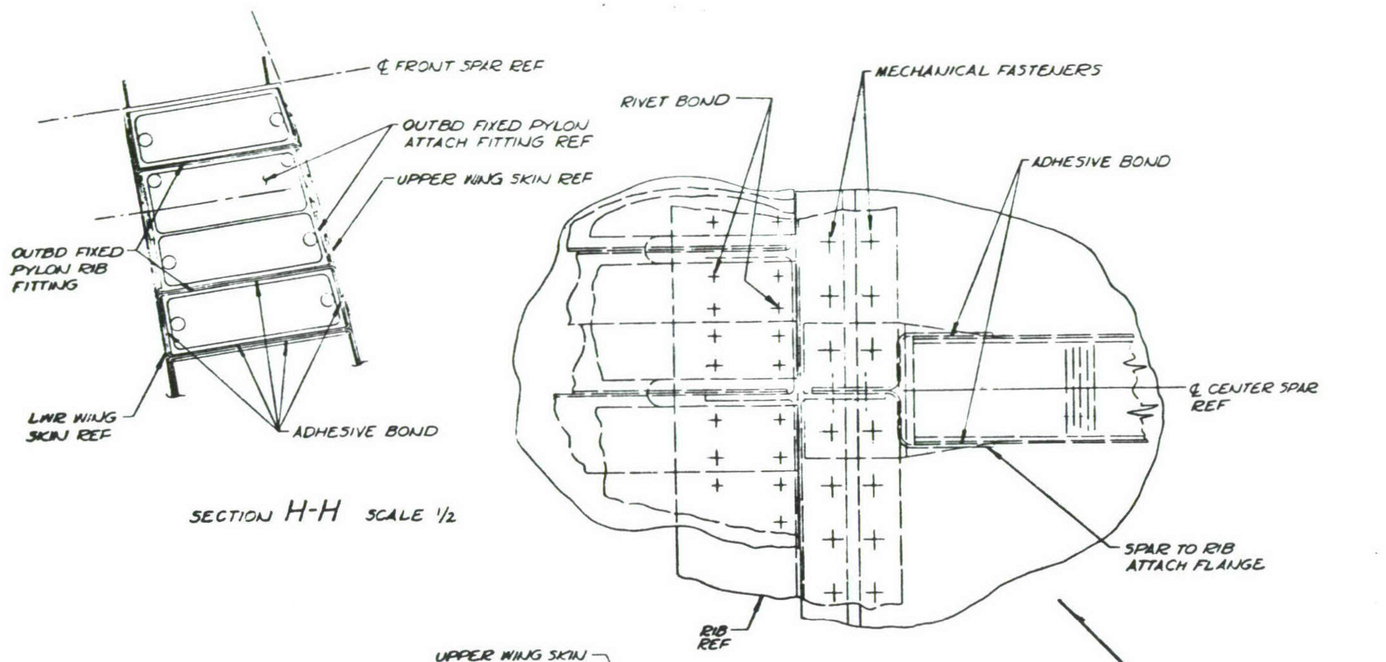
GENERAL DYNAMICS
Convair Aerospace Division

610RW007

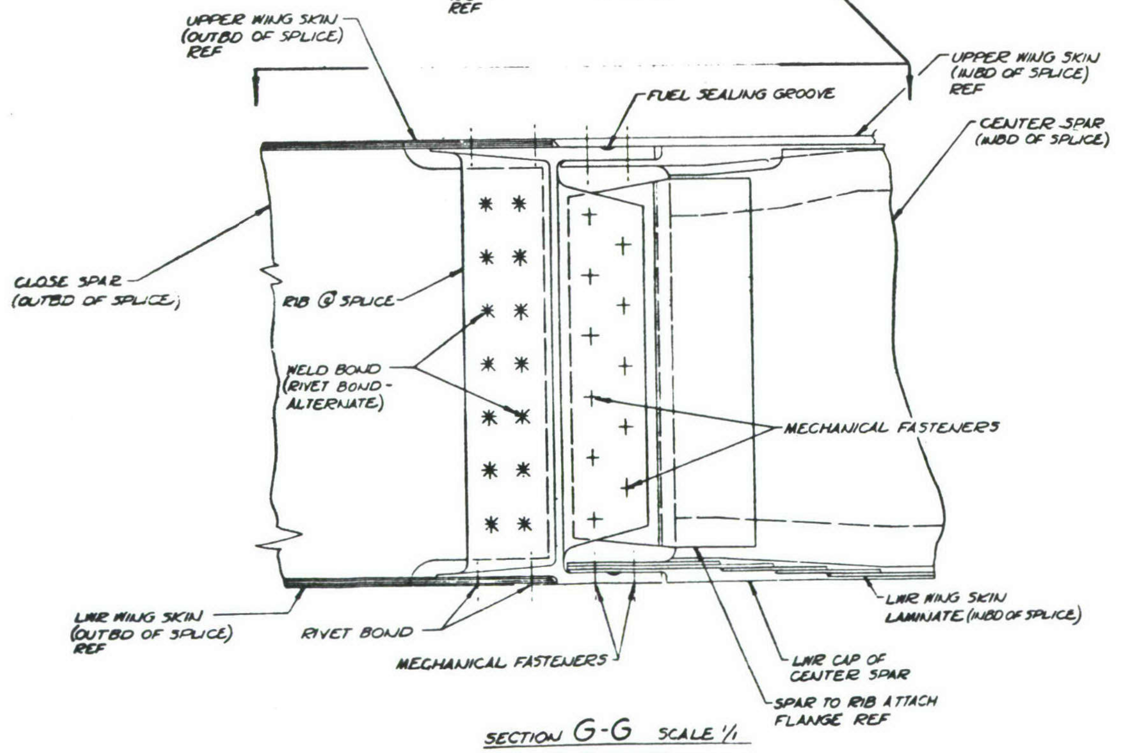
610RW007 Sheet 2



610RW008 Sheet 1



SECTION H-H SCALE 1/2



SECTION G-G SCALE 1/1
ROTATED 5° CLOCK

PART NAME	MATERIAL	FINISHED WEIGHT (LB)	
UPPER SKIN	7050-T76 AL	2.85	OUTBD SECTION
LOWER SKIN	↕	2.85	
INTERIOR SKINS		18.00	
INTERIOR SPAR HALVES		17.60	
FRONT SPAR		4.99	
REAR SPAR	7050-T76 AL	5.10	
SHIM	GRP	2.04	
ADHESIVE	AF143 (3M CO)	11.24	
LWR SKIN LAMINATES & LWR SPAR CAPS	7050-T76 AL 7050-T736511	290.80	INBD SECTION
UPPER SKIN & UPPER SPAR CAPS	7050-T7651 7050-T73651	374.00	
SPAR WEBS & CORE	7050-T76 4.5#CU.FT.	70.60	
HAT SECTION SUPPORTS	7050-T73651	24.10	
SPLICE RIB	7050-T736511	10.36	
ADHESIVE	AF143	58.60	
FASTENERS		33.80	
SEALANT, PYLON ATTACH FITTINGS & BUILD-UPS, FLAP TRACK ATTACH BUILD-UPS & BULKHEADS		355.00	

TOTAL WT = 1282 LB

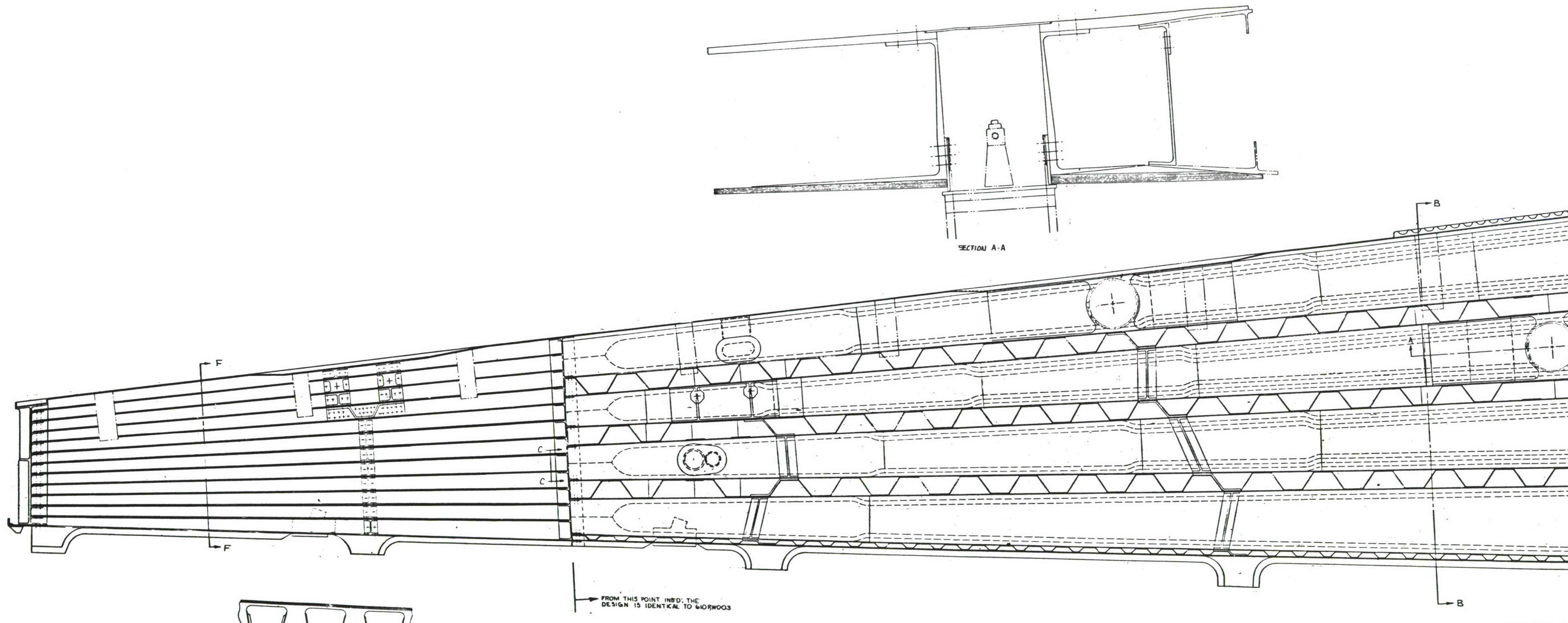
PRELIMINARY DESIGN DRAWING

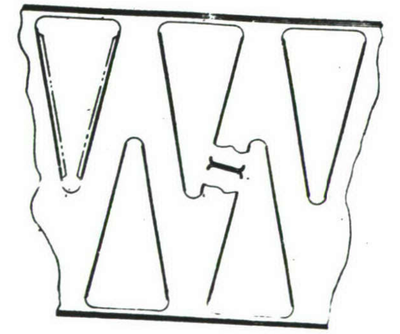
BONDED AL LAMINATED LOWER PANEL
HAT STIFFENED UPPER PANEL -
WITH TIP HAVING CLOSE SPAR SPACING

GENERAL DYNAMICS
Convair Aerospace Division
Fort Worth Operation

610RW008

610RW008 Sheet 2





SECTION G-G
SCALE ~ 1/1
TYP CONSTRUCTION FOR
ALL INTERIOR SPARS

PART NAME	MATERIAL	FINISHED WEIGHT	
UPPER SKIN	7050-T76 AL	2.85	OUTBOARD SECTION
LOWER SKIN		2.85	
INTERIOR SKINS (24)		18.00	
INTERIOR SPAR HALVES (22)		17.60	
FRONT SPAR		4.99	
REAR SPAR	7050-T76 AL	5.10	
SHIM	GRP	2.04	
ADHESIVE	AF 143 (3M C°)	11.24	
LOWER SKIN LAMINATES	7050-T76 AL	119.10	INBOARD SECTION
UPPER SKIN		295.27	
LOWER SPAR CAPS		171.70	
UPPER SPAR CAPS		51.57	
SPAR WEBS	7050-T76 AL	75.03	
ADHESIVE	AF 143 (3M C°)	15.18	
FASTENERS		13.73	
SPLICE RIB @ CSS 280		10.86	
PYLON FITTINGS, FLAP TRACK BUILD-UPS; TIP BHD, ETC.		355.00	
ADDITIONAL MATL. REQD. TO ACCOMPLISH ROOT SPLICE		35.45	
		1207.6	

610RW009 Sheet 1

PRELIMINARY DESIGN DRAWING

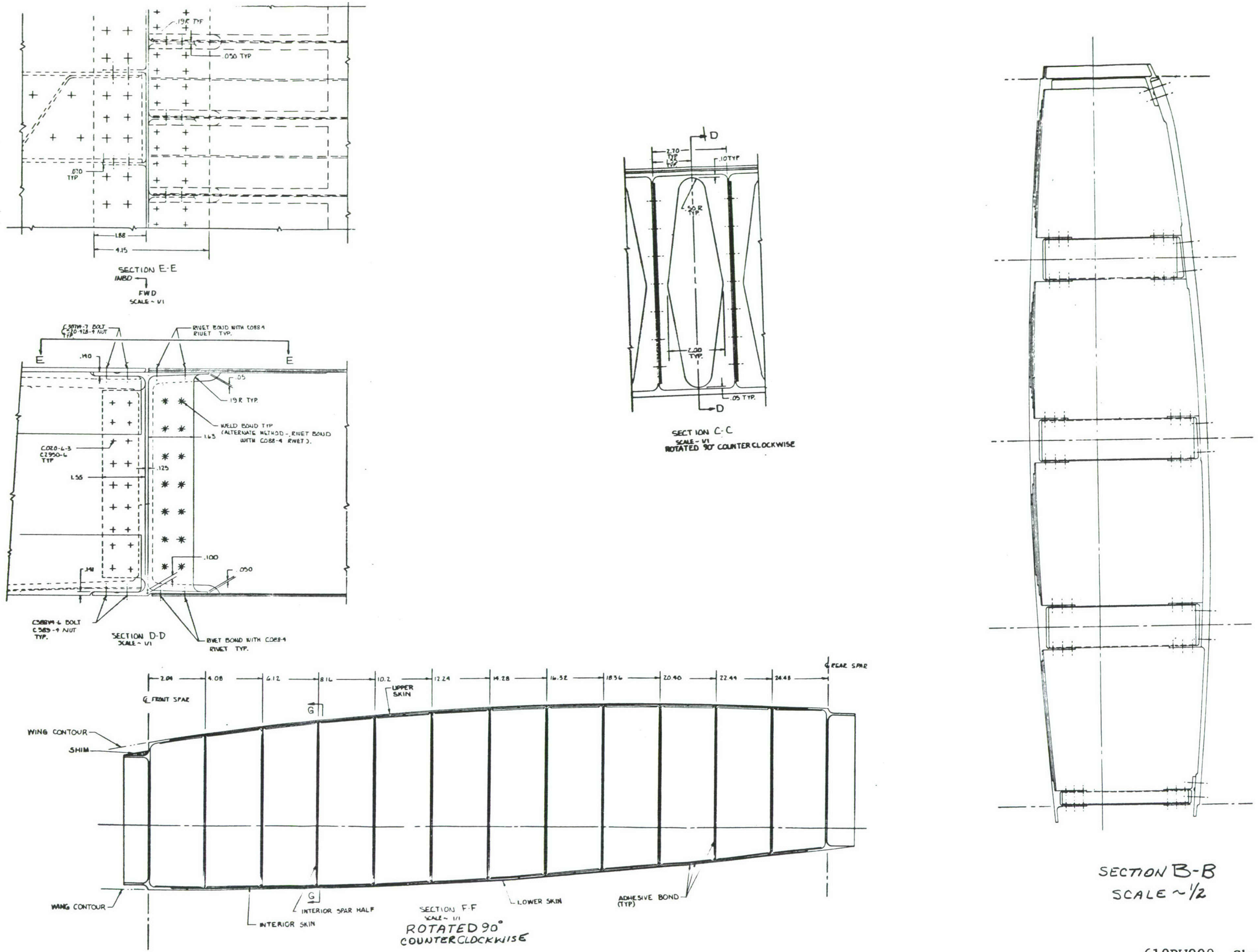
LAMINATED LWR. SKIN/PLATE UPR. SKIN/ CORRUGATED SPAR SPLICED WITH ADHESIVE-BONDED [illegible] SPAR (ALUM)

27 APR 73

GENERAL DYNAMICS

Convair Aerospace Division

610RW009



610RW009 Sheet 2

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13. ABSTRACT

This report describes the preliminary design and analysis for an Advanced Air Superiority Fighter Stores Loaded, Wet Wing Structure. The wing box of the F-111F airplane designed by the Convair Aerospace Division of General Dynamics was used as the baseline vehicle.

A unique design methodology was followed to arrive at three configurations which offer an optimum balance between structural efficiency and technological advancement. This methodology consists of compiling element concepts; integrating them into cross-section drawings; optimizing them in analytical assemblies; and finally preparing full wing box designs. Each step was followed with a detailed evaluation and ranking step which utilized a formal merit rating system. This system permitted the evaluation of numerous concepts and insured that each technical discipline participated in the design selection.

A subsequent program is proposed to evaluate the capability of the selected design to meet the overall program goals of advancing technology without significantly affecting costs. The subsequent program involves additional preliminary design, a development test program, detail design, manufacture, and tests; including static, fatigue, and damage tolerance testing. Information generated during this effort will be disseminated to the Air Force and industry in general through an intensive information transfer effort.

Unclassified
Security Classification

14. KEY WORDS	LINK A		LINK B		LINK C	
	ROLE	WT	ROLE	WT	ROLE	WT
Structural Design						
Stress Analysis						
Fatigue						
Fracture Analysis						
Materials						
Mass Properties						
Value Engineering						
Manufacturing Engineering						
Nondestructive Inspection						
Quality Assurance						

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Security Classification

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